Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

HYDROGEOLOGICAL ASSESSMENT
WEST HALF LOT 21, CONCESSION 9 (ESQUESING)
GLEN WILLIAMS, ONTARIO

Prepared For: **2147925 Ontario Inc.**
c/o Condeland Engineering Limited
350 Creditstone Road, Unit 200
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Attention: Mr. Romas Kartavicius
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EXECUTIVE SUMMARY

Terraprobe Inc. (Terraprobe) was retained by 2147925 Ontario Inc., to complete a Hydrogeological Assessment at the property (herein referred to as "Property" or "Site") located to the northwest of Georgetown on Part of the West Half of Lot 21, Concession 9 (Esquesing), Hamlet of Glen Williams, in the Regional Municipality of Halton, Ontario.

The Property is situated approximately 60 metres east of Eighth Line and approximately 110 metres north of Wildwood Road, in Glen Williams, Halton, Ontario. The Site is roughly rectangular in shape and covers an area of approximately 6.88 hectares (17.0 acres). The Site is currently an undeveloped agricultural land, and the access to the Property is via McMaster Street and Meagan Drive. The Site is located in a predominately residential and agricultural land use area. The Site location and layout can be seen on attached Figures 1 and 2.

Terraprobe understands that 2147925 Ontario Inc. is considering the future development of the Property with a total of thirty-two (32) single detached lots, serviced by an internal public roadway. It is understood that future developments will be serviced with municipal piped water and sanitary and storm sewers. The purpose of this evaluation is to provide information regarding the hydrogeological consideration for the proposed development of the Property.

The Property falls within the drainage area for the Credit River watershed. The closest natural surface water feature to the Site is Credit River West Branch (which is fed by Silver Creek), which is located approximately 300 m southwest of the Property. The overall objective of this assessment is to verify the hydrogeological conditions of the Property, the presence of groundwater receptors at the Site and immediate surroundings, and the potential impacts of development on natural groundwater functions for the Site, surrounding area and for the Credit River Watershed.

The scope of work consisted of a review of background information for the Site and the Credit River watershed, completion of a subsurface investigation consisting of installation and monitoring of seventeen (17) monitoring wells installed to various depths across the Site, and measurement of water levels.

Based on the studies conducted at the Site, the following conclusions can be made regarding the hydrogeological function of the subject Property:

1. The Site's stratigraphy consisted of a surficial topsoil layer of 150 to 280 mm, underlain by native soil deposits, which in turn were underlain by weathered shale bedrock. The native soils at the Site consisted of sandy clayey silt to clayey silt, which extended to the full depth of investigation in all borehole locations with the exception of four (4) boreholes BH 2, BH 3D, BH 6, and BH 7D located at the northern portion of the Property. Weathered shale bedrock was encountered in boreholes BH 2, BH 3D, BH 6, and BH 7D at depths of approximately 4.6 to 6.1 m below ground surface.

2. Sand seams were noted in two boreholes locations, BH 12 at depth of approximately 1.5 to 6.1 m below ground surface and BH 13.0 at depth of approximately 2.3 to 3.0 m below ground surface. BH 12 and BH13 are located at the southern portion of the Property.

3. Based on the (manual) groundwater monitoring events, groundwater elevation within the monitoring wells installed in the overburden varies from elevation ± 273.78 metres above sea level (masl) (MW3S) located at the north corner of the Property to elevation ± 265.86 masl (MW 9) located at the southeast corner of the Property.

4. Based on the groundwater monitoring data analysed from data loggers installed at the Site for 2-year monitoring program (November 2018 - November 2020), the groundwater elevation at the Site varies from elevation ± 274.05 masl (MW3S) located at the north corner of the Property to elevation ± 266.59 masl (MW12S/D) located at the south corner of the Property indicating the groundwater flow direction towards south/southwest similar to the trend observed based on the manual groundwater monitoring events.

5. Vertical hydraulic gradients were calculated at nested monitoring well locations. Weak downward hydraulic gradients were observed at each nested installation across the Site. Areas of groundwater discharge were not observed during the Site inspection. The primary function of the Site is limited groundwater recharge to underlying groundwater systems due to the medium to low hydraulic conductivity of the overburden soils.

6. A review of the MECP water well database for all wells within 500 m of the Site and a door-to-door well survey was conducted. Majority of the properties in the vicinity of the Site are serviced by municipal supplied water. One Property to the west of the Site, utilizes a private well for domestic use.

7. Impacts to surrounding private wells are not anticipated. Residential buildings in the vicinity of the Site to the east and south of the Site are serviced with municipal water and private on-site septic tank systems. A private well exists to the west of the Site. This well is completed within the deep bedrock. Impacts to deeper groundwater systems as a result of Site development are not anticipated.

8. The overburden soil at the Site generally consists of low permeability clayey silt material, which will preclude the flow of groundwater into the excavation. The hydraulic conductivity of the overburden soils, based on the in-situ rising head test, was between 10^{-7} to 10^{-8} m/s.

9. There are no nearby surface water features within the vicinity of the Property. The Property will be serviced with municipal piped water and sanitary and storm sewers and the surrounding area is serviced with municipal piped water and individual septic tank systems. As such, it is not anticipated that there will be any impacts to local wells or natural features as a result of the groundwater control activities during construction.

10. The results of laboratory analysis on the groundwater samples obtained from the Property indicated that the nitrate concentration in the groundwater is generally low, with the exception of BH14. The elevated nitrate concentrations in the on-site groundwater monitoring wells, are assumed to be the result of the former use of the Site for farming practices (livestock).

11. The water balance calculations show that development has potential to reduce the natural infiltration by 5,163 m^3/a, and to increase the runoff by 17,350 m^3/a. If roof top runoff water i.e., 13,445 m^3/a is re-infiltrated through storm water management features, a total of 12,100 m^3/a of water could be available for infiltration under post-development conditions (assuming 90% available of the run-off captured). Approximately 28% of the effective roof runoff captured will be required to compensate the post-development infiltration deficit. This indicates that, with proper storm water management and mitigation measures, the overall infiltration rates at the Property can be maintained.

12. The Site is located partially within a Significant Ground Water Recharge Area (SGRA). Mitigation measures such as conventional low impact development (LID) storm water management measures should be applied to maintain and enhance natural infiltration. Final design of the LID measures should be reviewed in conjunction with the storm water management plan for the Site.

13. The groundwater control requirements at the Site are summarized below:

Groundwater Quantity: Short Term (Construction) – S.F. 1.5 Used								
Excavation	**Groundwater Seepage**		**25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
4 Lot Basements (in the Lot 7 to Lot 32 area) North of Megan Drive	4,000	2.78	32,000	22.22	**36,000**	25.0	**No**	**No**
4 Lot Basements (in the Lot 1 to Lot 6 area) South of Megan Drive	136,000	94.44	32,000	22.22	**168,000**	116.67	**Yes**	**No**
Gravity Sanitary Sewer Installation (100 metre length) North of Megan Drive	4,000	2.78	5,000	3.47	**9,000**	6.25	**No**	**No**
Gravity Sanitary Sewer Installation- (100 metre length) South of Megan Drive	89,500	62.16	5,000	3.47	**94,500**	65.63	**Yes**	**No**
Storm Sewer Installation (100 meter length) North of Megan Drive	3,000	2.09	5,000	3.47	**8,000**	5.56	**No**	**No**
Storm Sewer Installation- 100 metre length) South of Megan Drive	79,500	55.21	5,000	3.47	**84,500**	58.68	**Yes**	**No**
Watermain Installation (100 metre length) North of Megan Drive	2,500	1.74	5,000	3.47	**7,500**	5.21	**No**	**No**
Watermain Installation (100 metre length) South of Megan Drive	2,000	1.39	5,000	3.47	**7,000**	4.86	**No**	**No**
Groundwater Quantity: Long Term (Post Construction) – S.F. 1.5 Used								
Location	**Groundwater Seepage**		**Infiltration 25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
Single Lot Basements (Lot 1 - Lot 32) Entire Subdivision	86,000	59.72	32,000	22.22	**118,000**	**81.94**	**No**	**Yes**

Based on the above conclusions of the hydrogeological assessment the following recommendations are made:

1. In order to maintain the natural groundwater function at the Site it is recommended to implement LID techniques. By implementing LID features at the Site under a Best Management Practice the natural groundwater function at the Site can be maintained or enhanced.

2. In addition, a test pit investigation is recommended at the proposed areas for LID measures at the Property to identify areas at the Site which would be suitable for infiltration measures.

3. Infiltration capacity of the soil within this area should be assessed by conducting saturated field permeability. The test pits should be excavated to depths of 2 to 2.3 m below prevailing ground surface and in-situ infiltration tests using Guelph Permeameter be conducted at selected representative locations within the upper 300-600 mm zone of the investigation depth. The information from the saturated field permeability test results will provide the soil percolation rate and assessment of hydraulic capability of the surficial soils at the Property. Infiltration testing is not completed at the Site due to weather constraints.

4. Upon completion of hydrogeological investigations at the Site it is recommended that all monitoring well installations be decommissioned by a licensed well driller in accordance with O. Reg. 903.

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1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by 2147925 Ontario Inc., to complete a Hydrogeological Assessment at the property (herein referred to as "Property" or "Site") located to the northwest of Georgetown on Part of the West Half of Lot 21, Concession 9 (Esquesing), Hamlet of Glen Williams, in the Regional Municipality of Halton, Ontario.

The Property is situated approximately 60 metres east of Eighth Line and approximately 110 metres north of Wildwood Road, in Glen Williams, Halton, Ontario. The Site is roughly rectangular in shape and covers an area of approximately 6.88 hectares (17.0 acres). The Site is currently an undeveloped agricultural land, and the access to the Property is via McMaster Street and Meagan Drive. The Site is located in a predominately residential and agricultural land use area. The Site location and layout can be seen on attached Figure 1 and 2.

Terraprobe understands that 2147925 Ontario Inc. is considering the future development of the Property with a total of thirty-two (32) single detached lots, serviced by an internal public roadway. It is understood that future developments will be serviced with municipal piped water and sanitary and storm sewers.

A hydrogeological assessment is required to determine the potential impacts of the proposed development on existing groundwater resources at the Site and in the general vicinity. The study is generally required to identify potential impact to base flow, local streams or significant natural features in the area. The hydrogeological study will be conducted to assess the subsurface conditions, soil stratigraphy, and groundwater table and flow direction.

The purpose of this evaluation is to provide information regarding the hydrogeological consideration for the proposed development of the Property. Specifically, this report provides the following:

- A description of the hydrogeological setting of the Property and a summary of the existing soil and groundwater conditions at the Site.
- An assessment of hydrogeological features and functions of the Site.
- Identification of sensitive hydrogeological features such as zones of significant groundwater recharge and discharge.
- Calculations of water balance for existing (pre-development) conditions.
- Calculation of water balance for post-development conditions, along with recommendations for appropriate LID measures to maintain groundwater infiltration rates.
- Recommendation for excavation dewatering pumping rate and water quality measures.
- Information for appropriate mitigation measures to maintain hydrogeological functions following Site development.

2.0 SCOPE OF WORK

The hydrogeological assessment included the following scope of work:

- *Background Information Review*: A review of available geological and hydrogeological information for the Site and surrounding areas was conducted. The provided background information was reviewed to allow for characterization of regional hydrogeological conditions. The information reviewed included topographic mapping, geological mapping, previous environmental reports and Ministry of the Environment, Conservation and Parks (MECP) water well records.
- *Review of background information and meteorological data:* A review of meteorological data was completed to assess local climate and seasonal variations.
- *Detailed Site Inspection:* A detailed visual inspection of the Site and surrounding area was conducted to determine local topography, drainage, and an assessment of potentially hydrogeological significant features such as closed depressions (potential areas of groundwater recharge), seeps, springs, or groundwater discharge to the on-site drainage features.
- *Subsurface Investigation:* The subsurface investigation of the Site consisted of drilling a total of seventeen (17) exploratory boreholes (denoted as BH1 to BH14, with three (3) nested wells) that were advanced across the Property to depths ranging from about 3.0 to 18.0 m below grade. Prior to the commencement of drilling, the locations of underground utilities, including telephone, natural gas and electrical lines, were marked out by local locating companies and individual borehole locations were cleared by private utility locating service providers. The subsurface investigation was completed to assess Site specific shallow soil and groundwater conditions including vertical and horizontal extent of potential groundwater bearing zones throughout the Site. The extent and thickness of the overburden across the Site was also determined.
- *Well Installation:* To measure the groundwater level and investigate the quality of groundwater, all the seventeen (17) boreholes, at fourteen locations across the Site, were instrumented with a monitoring well (fourteen (14) monitoring wells with three (3) nested wells). The monitoring well consisted of a 50 mm diameter PVC screen with a length of PVC riser pipe, 5 or 10-ft slotted screen and finished at surface with protective lockable steel casings. Upon installation, an elevation survey of the monitoring wells, relative to a local datum, was completed so that relative groundwater flow direction could be assessed. The information obtained from the boreholes was used for the hydrogeological assessment.
- *Groundwater Level Monitoring:* Groundwater levels were obtained from all available monitoring wells completed on-site to determine the direction of groundwater flow. Groundwater levels were monitored over five (5) monitoring events. In order to capture the seasonal groundwater fluctuations, a 2-year groundwater monitoring program was conducted on the Site from November 2018 to November 2020 using the programmed pressure transducers (data loggers). Groundwater levels were monitored and elevations were surveyed to a local benchmark.
- *Hydraulic Conductivity Tests:* The hydraulic conductivity of the various strata was estimated based on grain size distribution, and rising head permeability tests in the wells. In-situ hydraulic

conductivity tests (rising head tests) of the underlying soils were conducted in five (5) selected monitoring wells to assess hydraulic conductivity of the strata. This information was used to estimate groundwater flow and potential requirements for groundwater control.

- *Private Well Survey:* A door to door survey of private wells was conducted for properties within approximately 500 m of the Property boundary. The information collected from the survey was used to assess potential effects of the purposed development on existing wells in the area.
- *Water Sampling and Chemical Analysis:* Nine (9) groundwater samples were collected and analysed for nitrate/nitrite to acquire baseline information.
- *Contaminant Attenuation Assessment:* A nitrate attenuation (nitrate loading balance) analysis was completed in accordance with the Ministry of Environment, Conservation and Parks (MECP) Procedure D-5-4: Technical Guidance for Individual On-Property Sewage: Water Quality Impact Risk Assessment (1996).
- *Construction Dewatering Flow Rate Estimate*: Considering the proposed development plans, the construction dewatering flow rate (short-term dewatering) was estimated using the stable groundwater level and estimated hydraulic conductivity measured in the Site.
- *Long-Term Foundation Drainage:* Considering the proposed development plans, potential long-term foundation drainage flow rate was estimated.

Following completion of the above-noted study, a detailed engineering report was prepared regarding the Site hydrogeology. The report provides the following information:

- Description of the work program and factual information gathered during the study including the results of the Site inspection and water level measurements. The results of the subsurface investigations including borehole logs and grain size analysis were reviewed and summarized.
- Identification of significant hydrogeological features and functions at the Site. The report identified the local groundwater functions, particularly with respect to the natural environment. This included identification of areas of groundwater recharge, discharge and storage. Any significant or sensitive hydrogeological features were identified. This included groundwater supply wells, areas of high groundwater table, or natural features which may rely on groundwater.
- Water balance for the pre-development and post development conditions were conducted using the Thornthwaite approach. The water balance was conducted using climate information obtained from the nearest Environment Canada weather station. Climate data was used for average, dry and wet year conditions to indicate the range of infiltration conditions.
- Assessment of anticipated groundwater inflow if excavations are carried below the groundwater table and assessed any permit requirements of any construction dewatering and permanent drainage control at the Site

3.0 DESCRIPTION OF SITE CONDITIONS

3.1 Property Location and Description

The Site is located to the northwest of Georgetown on Part of the West Half of Lot 21, Concession 9 (Esquesing), Hamlet of Glen Williams, in the Regional Municipality of Halton. It is situated approximately 60 metres east of Eighth Line and approximately 110 metres north of Wildwood Road, in Glen Williams, Halton, Ontario. For the site description purposes, Eight Line is considered to be oriented in a north-south direction and Willowdale Road in an east-west direction.

The Site is roughly rectangular in shape and covers an area of approximately 6.88 hectares (17.0 acres). The Site is currently an undeveloped agricultural land. Access to the Property is from via McMaster Street and Meagan Drive. The Site is located in a predominately residential and agricultural land use area. The Site location and layout can be seen on attached Figures 1 and 2.

The study was undertaken to assess the geological and hydrogeological conditions at the Site and to provide information regarding the potential impacts of the proposed development on the groundwater function.

3.2 Proposed Development Plan

It is understood that the proposed development of the Property will involve the construction of thirty-two (32) single detached lots, serviced by an internal public roadway. It is understood that future re-developments will be serviced with municipal piped water and sanitary and storm sewers. The proposed development plans are under preparation. Conceptual development plans “Conceptual Grading Plan and Conceptual Servicing Plan” prepared by Condeland Consulting Engineers for the West Half of Lot 21, Concession 9 (Esquesing), Glen Williams, is presented in Appendix A.

3.3 Surrounding Land Uses and Servicing

The Property is situated in a predominantly suburban/rural area. Most of the surrounding lands are rural residential or agricultural in use. The lands to the east, south and west of the Property consist of an existing residential subdivision, and rural/residential properties. The lands to the north of the Property consist of agricultural properties. The Property is bordered to the east, south and west by houses along Eighth Line, Wildwood Road and Oak Ridge Drive. The surrounding properties are serviced by municipal piped water and individual on-site septic systems.

3.4 Site Topography and Drainage

Topography of the Site is relatively flat with slight slopes towards the north and south towards Eighth Line. The total elevation drop across the Site is on the order of 4.0 m. The southwest corner of the

Property has an elevation of 271 masl that increases to approximately 275 masl to the northeast and remains consistent to the east and west. The Property is approximately 200 m above the level of Lake Ontario. There are no watercourses present on the Site.The closest natural surface water feature to the Site is Credit River West Branch, which is located approximately 300 m southwest of the Property. The regional groundwater flow at the Site is expected to be in a southwestward direction towards Credit River West Branch, ultimately flowing south towards Lake Ontario.

3.5 Regional Physiography

The Site is located within the Silver Creek Subwatershed, part of the Credit Valley Conservation Watershed. From a regional perspective, the Site is situated within the physiographic region of Ontario known as the Niagara Escarpment, and within a regional physiographic landform feature known as Spillways. The Niagara Escarpment is characteristic of a thin to absent overburden cover and where dolostone bedrock and boulders are present. The area is drained in the southwest by Credit River West Branch (which is fed by Silver Creek), which general flows southward towards Lake Ontario.

3.6 Regional Geology

According to the geological map entitled “Quaternary Geology of Ontario-Southern Sheet” Map 2556, published by the Ministry of Northern Development and Mines, dated 1991, the overburden in the region of the Property is consists of Paleozoic bedrock and clay to silt-textured till.

According to the bedrock geology map entitled “Bedrock Geology of Ontario-Southern Sheet” published by the Ministry of Northern Development and Mines dated 1991, the bedrock of the area is part of the Queenston Formation. The bedrock in the region comprises of shale, siltstone, minor limestone and sandstone. It should be noted that the subsurface soil, rock and groundwater conditions described above represent generalized conditions only, and should not be considered Site specific.

From a geological point, the Property is located in a thin layer of clay to silt-textured till deposits created by glacial ice.

A subsurface investigation was conducted as part of the current Hydrogeological Assessment. Based on the subsurface investigation conducted at the Property, the Property is underlain by a 150 to 280 mm thick surficial topsoil layer in all boreholes. Native soils are found underneath the topsoil layer, and consisted of sandy clayey silt to clayey silt which extended to the full depth of investigation in boreholes BH 1, 4, 5, 7, 8, 9, 10, and 11. Sand seams were noted in boreholes BH 12 and 13 ranging from 1.5 to 6.1 m below ground surface. Weathered bedrock was encountered in boreholes BH 2, 3 and 6 at depths of approximately 4.6 and 6.1 m below ground surface.

3.7 Regional Hydrogeology

The Site is situated within the Silver Creek Subwatershed, within the Credit River Watershed, which comprises of two (2) regionally extensive aquifers: a shallow overburden aquifer within the glacial till strata and a deeper bedrock aquifer.

The groundwater flow systems follow local and regional topography. The shallow flow systems are typically a subdued reflection of local topography, with recharge over higher areas of ground, and local discharge in water courses, valleys, swales or wetlands. The shallow groundwater is expected to be towards Credit River West Branch to the southwest. The deeper flow systems follow regional topography. The deeper flow systems in the vicinity of the Site are generally directed to the southwest following the regional slope of the land. Regional groundwater flow is expected to be in a southerly direction towards Lake Ontario. Locally, near surface groundwater flow may be influenced by the presence of large wetlands, baseflow contributions from private sewage systems or surface water courses including Credit River West Branch that flows southeast.

The soil underlying the Site, as encountered during the subsurface investigation, is interpreted to be part of the Halton Till Aquitard, which overlies all of the above-mentioned regionally extensive aquifers in the area.

The Ontario Ministry of Natural Resources National Heritage Information Centre database for listings of Areas of Natural or Scientific Interest (ANSIs) was reviewed. According to the database, there are no ANSIs identified within the Property and the Study Area.

3.8 Local Climate

The Property is located in the climatic region of Southern Ontario known as the Niagara Escarpment region. The following general climate data was obtained from Environment Canada publications and from the Environment Canada online database. Average climate data was taken from the Georgetown Waste Water Treatment Plant (WWTP) station (the closest station with historical data to the Property) for the period of 1979-2017. The following Tables present the information for the station and average climate data.

Table 3.7-1: Weather Station

Station	Climate ID	Latitude	Longitude	Elevation
Georgetown WWTP	6152695	43°38'24.018" N	79°52'45.018" W	221.00 m

Table 3.7-2: Summary of Climate Data

Mean monthly temperature	7.3 C
Mean annual precipitation	749 mm
Mean annual evapotranspiration	505 mm
Mean annual water surplus	244 mm

The climate is typical for Southern Ontario, with rainfall exceeding evapotranspiration. It is noted that the above are averaged values, which are representative in a regional context. There will be seasonal and

annual variations in these values. However, the average values will govern long-term groundwater recharge and discharge rates. Therefore, average values are approximate for assessment of hydrogeological conditions at the Site. The climate data taken from the Georgetown WWTP Station is presented in Appendix F.

3.9 Groundwater Resources

Private well records on file with the Ministry of the Environment, Conservation & Parks were reviewed for wells located in the study area. Information contained in these records provides data for determining the nature and use of local groundwater resources. A total of 110 wells were located within 0.5 km radius. Information regarding the wells is presented in Appendix B. Location of MECP records are presented on Figure 4. A summary of data obtained from these MECP records is presented in the following Table.

Table 3.9.1: Summary of Local Water Wells

Total Number of Wells	**110**
Wells completed in Overburden	31 (28.1%)
Wells completed in Bedrock	61 (55.5%)
Unknown	18 (16.4%)
Depth Ranges	
Unknown	3 (2.7%)
50 ft or Less	29 (26.3%)
51 ft to 100 ft	56 (51%)
101 ft to 200 ft	22 (20%)
Water Use	
Domestic/Livestock	83 (75.5%)
Industrial	1 (0.9%)
Irrigation	1 (0.9%)
Monitoring	4 (3.6%)
Unknown/Not Used	21 (19.1%)
Water Quality	
Fresh	84 (76.4%)
Salty	5 (4.5%)
Unknown or Dry	21 (19.1%)

Reported Pumping Rates	
0 to 23 LPM (0 to 5 GPM)	40 (36.4%)
23 to 45 LPM (5 to 10 GPM)	23 (20.9%)
45 to 68 LPM (10 to 15 GPM)	13 (11.8%)
68 to 91 LPM (15 to 20 GPM)	3 (2.7%)
> 91 LPM (> 20 GPM)	7 (6.4%)
Unknown or Dry	24 (21.8%)

The above summary indicates that most local wells (76%) registered in the area are used for domestic/livestock use, and most local wells (56%) obtain their water supply from the bedrock aquifer and the rest were primarily listed as overburden.

The stratigraphy information from the records for most wells indicated that clay till material are present at the ground surface, followed by layers of clay till intermixed with layers of silt, sand and gravel, overlaying shale bedrock. Based on the well records, it is evident that most local wells draw water from the bedrock aquifer.

Residential areas to the east, south and west of the Site are serviced by municipal water and individual septic systems. Wells within this area have likely been decommissioned and are no longer in operation. The Property and surrounding areas are situated in a well head protection area of Credit Valley source water protection zone. A door to door well survey was conducted for the Property.

3.10 Results of Door-to-Door Survey

A door –to- door water well survey of local residents located in the vicinity of the Property was conducted. The survey was conducted on November 5 through 18, 2018, and included properties located within a 500 m radius of the Site. During the survey, a questionnaire was completed with the well owner, where possible. At properties where no one was available to complete the questionnaire, a letter was left informing the occupant about the survey and providing the resident with contact information should they wish to participate in the survey. An example of the well questionnaire and letter provided to residents are provided in Appendix G. A summary of the results of the private well survey is provided in Appendix G and summarized in the table below:

Table 3.10-1: Summary of Door-to-Door Well Survey

Total Number of Properties Visited	55
Total Number of Responses	3
Total Confirmed on Municipal Supply	2
Total Confirmed Using Well for Drinking	1
Total Confirmed Using Well for Non-Drinking Uses	0
Total Unknown	52
Depth Ranges	
Less than 7.5 m	0
7.5 m to 15 m	0
15 m to 30 m	1
Well Water Use	
Domestic	1
Well Types	
Dug	0
Drilled	1
Resident Reported Issues	
Quality Issues	0
Quantity Issues	0

There are about fifty-five (55) properties that were identified as possible private well users within 500 m of Property boundary, as shown on the attached Figure 7. A representative of Terraprobe visited each property to obtain information regarding their well(s) and water supply.

Three (3) of the fifty-five (55) property owners responded to the survey. One owner responded that the use of the private well is for drinking purposes. The other two owners responded as being on municipal supplied water. The remaining canvassed did not respond to the survey. In summary, there is at least one (1) surrounding property which utilizes water wells for water supply. Water supplies to the remaining properties in the area are unknown, as the residents did not respond to the surveys.

The drilled well was completed to a depth of approximately 36 m, and was reported as good water quality and quantity.

Based on our observation during the door to door survey, majority of the surrounding properties are serviced by municipal water and individual septic systems. Wells within this area have likely been decommissioned and are no longer in operation.

3.11 Site Inspection to Assess Hydrogeological Features

Features which are significant from a hydrogeological view point are of special interests to understand the hydrogeological dynamics of the subject area. In particular, the following features are of special interests:

- The presence of closed drainage features such as sandy areas, or depressions, which may allow for ponding and significant or enhanced infiltration of water.
- Assessment of the presence of phreatophytic vegetation which may indicate seasonally high groundwater levels and/or groundwater discharge and seepage.

No significant areas of groundwater recharge (such as depressions or kettles) were identified on the Property. Runoff at the Property generally drains by diffuse overland flow towards the southwestern Property boundary, or the eastern Property boundary ditch. Although the Site comprises of vegetative cover and a naturally uneven topography, no ponding of surface water is expected. Therefore, no such hydrogeological features are present on the Property for further investigation.

3.12 Review of Current Regulatory Requirements

A review of current regulatory requirements associated with water supply and hydrogeology in connection with the proposed development was conducted, including those of the Hamlet of Glen Williams, the Credit Valley Conservation Authority, the Ministry of the Environment and Halton Region. Relevant information is provided below.

3.12.1 Source Protection Vulnerable Areas

Based on the review of MECP's Source Protection Information Atlas interactive mapping, the following information was obtained related to the subject Property:

Table 3.12.1: Source Protection Vulnerable Areas

Associated Policy Area	Applicability
Source Protection Area	Credit Valley
Wellhead Protection Area (WHPA)	No
Wellhead Protection Area (WHPA) E (GUDI)	Yes, Score: 9 (Partially- Southern Portion)
Significant Groundwater Recharge Area (SGRA).	Yes, Score: 6 (Partially- Northwest Portion)
Highly Vulnerable Aquifer (HVA)	Yes, Score: 6 (Partially- Southern Portion)
Wellhead Protection Areas (WHPA - Q1, WHPA - Q2)	Yes, Moderate
Intake Protection Zone	No
Intake Protection Zone Q	No
Issue Contributing Area	Yes, Contaminant: Chloride

Refer to Appendix A for associated regulatory mapping details.

3.12.2 Credit Valley Conservation Authority

The Property is located within Subwatershed 11 of the Credit River Watershed. A review of the "*Credit Valley Source Protection Area Assessment Report*" (2018) indicates that the southern Property edge is located within a Wellhead Protection Area-E (WHPA-E). This designation is based on a raw water supply that is groundwater under direct influence of surface water (GUDI).

Information regarding the potential vulnerability of the bedrock aquifer in the Site was obtained based on Regional geological mapping and MECP wells records, as presented in the hydrogeological report. As noted on the cross-section figures in the report (Figures 5 and 6) the surficial deposits are characterized by

lower permeability silt or clay materials. The thickness to the bedrock is typically between 4.6 and 15.0 m.

It is recognized that the bedrock aquifer may be highly vulnerable in other areas, where there is thinner soil cover or the soil consists of highly pervious surficial deposits. However, the well records and on-site investigation confirm that the aquifer is protected by the overlying soil at and in the vicinity of the Site.

3.12.3 Other Regulatory Authorities

The Property is not located within the Niagara Escarpment Plan, the Oak Ridges Moraine Plan, or Natural Heritage Areas.

3.13 Previous Investigation

Previous work was completed by Terraprobe for the Property, and are summarized below.

Report Title	Preliminary Hydrogeological Assessment, Proposed Residential Subdivision, Part of West Half of Lot 21, Concession 9 (Esquesing), Hamlet of Glen Williams, Regional Municipality of Halton
Report Date	June 6, 2006
File No.	1-91-0198
Prepared By	Terraprobe Limited
Prepared For	G. Devins c/o Wellings Planning Consultants Inc.

Previous work was completed by Terraprobe in 2006, carried out across the Site. The investigation consisted of the completion of eleven (11) test pits to depths of approximately 3.0 to 4.0 m below ground surface, across the Site in 1991. The purpose of the study was to assess the following:

- The shallow soil and groundwater conditions as they relate to the design and construction of septic tank and tile field systems.
- The potential effect of tile fields on local groundwater quality and nearby residential water supplies (wells).

The results of the preliminary hydrogeological evaluation indicated the following:

- The Site is not situated in a hydrogeologically-sensitive area, based on the Halton Aquifer Management Plan.
- The Site is generally characterized by low permeability glacial till materials. These soils are suitable for the construction of individual septic systems. Fully raised filter beds or shallow buried trench systems will be required. It is understood that tertiary treatment units will be used at each lot.
- The Site will be serviced with municipal piped water. Immediately adjacent properties are currently serviced with municipal piped water.

- With the use of tertiary treatment units at each lot, the lot size for the development will be governed by the area required to Site the building envelope and tile field.

The following additional studies were recommended following the investigation:

- An updated door-to-door survey must be conducted to confirm the presence and nature of any remaining water wells within approximately 500 m of the Site.
- Several monitoring wells must be installed at the Site to assess shallow groundwater quality, particularly with respect to nitrate concentrations.
- Test pits must be dug on each lot after Site grading to confirm shallow soil conditions.
- The design and siting of the tile field systems must be conducted by a qualified professional, in accordance with the requirements of the Ontario Building Code.

4.0 SUBSURFACE INVESTIGATION

4.1 Subsurface Investigation

A subsurface investigation was conducted by Terraprobe in October 2018 to assess the soil and groundwater conditions at the Property.

The report provides an assessment of subsurface conditions at the Site based on a total of seventeen (17) exploratory boreholes at fourteen locations, (denoted as BH1 to BH14) advanced across the Property, extending to an approximate depth of 3 to 18 m (10 to 60 ft) below the existing grade.

The above-mentioned boreholes were instrumented with monitoring wells (fourteen (14) monitoring wells with three (3) nested wells) to assess the groundwater levels at the Site. The locations of these boreholes/monitoring wells are shown on the attached Figure 2. The boreholes were staked in the field by Terraprobe Inc. and the corresponding ground surface elevations were surveyed using a Trimble R10 GNSS System. The Trimble R10 system uses the Global Navigation Satellite System and cellular data to determine borehole and/or monitoring wells locations with GPS coordinates and their respective elevations. The Trimble R10 system has a precision of 0.5 m with respect to the GNSS and a precision of 5 mm with respect to elevation surveying.

The borings for all of the investigations were made using a continuous flight power auger track mounted machine equipped with conventional soil sampling and testing tools. Standard penetration testing was conducted at each borehole during drilling. The drilling was conducted under the full-time supervision of a member of our field staff who logged the borings and examined the samples as they were obtained. The results of the drilling are recorded in detail on the accompanying borehole logs available in Appendix C.

The approximate borehole locations are shown on the enclosed Borehole Location and Site Features Plan (Figure 2). The soil stratigraphy is presented below and recorded on the accompanying Borehole Logs (Appendix C).

4.1.1 Stratigraphic Conditions

In summary, the stratigraphic conditions of the Site are summarized below.

4.1.1.1 Topsoil

Topsoil materials extending from surface to a depth of 150 to 280 mm below grade were encountered in all boreholes.

4.1.1.2 Native Soils

4.1.1.2.1 Sandy Clayey Silt

A sandy clayey silt stratum of soils were encountered beneath the overlying topsoil at all borehole locations with the exception of Borehole BH10, where it was encountered below the clay silt soil at the

depth of 2.3 m below grade and extending to the depth of investigation. This soil stratum was encountered at depths ranging from about 0.15 to 0.3 m below grade in the remaining borehole locations (BH1, to BH14), and extended to depths of approximately 0.8 to 9.1 m below grade.

4.1.1.2.2 Clayey Silt

A clayey silt stratum of soil was encountered beneath and intermixed with the sandy clayey silt at depths ranging from about 0.8 to 6.1 m below grade to the depth of investigation or weathered bedrock. These deposits are noted to be clay and silt with some sand and trace gravel.

4.1.1.2.3 Gravel and Sand

Gravel and sandy soils were encountered at depths from about 1.5 to 2.3 m below grade in boreholes BH12 and BH13, and extended to depths of approximately 3.0 and 6.1 m below grade. These deposits are noted to contain some silt and trace clay, and were noted as compact, brown and moist.

4.1.1.2.4 Silt

A silt stratum of soil was encountered at depths from about 3.0 to 6.6 m below grade in borehole BH14. These deposits are noted to contain some sand, some clay and trace gravel, and were noted as very dense, brown and moist.

4.1.1.2.5 Sand

A layer of sand was encountered at depths ranging from about 6.6 to 7.9 m below grade in borehole BH14. These deposits are noted to be very dense, brown and wet.

4.1.1.3 Bedrock

Weathered shale bedrock was encountered underlying the overburden soil layers, extending to the depth of investigation in boreholes BH2, BH3D and BH6. The weathered bedrock deposits were grey to red in colour and were noted as damp and very dense.

4.2 Monitoring Well Installation

Monitoring wells were installed at all borehole locations. In total 17 monitoring wells (fourteen monitoring wells and three (3) nested wells) were installed at 14 monitoring locations. Monitoring wells consisted of a two-inch diameter schedule 40 PVC pipe with a No. 10 slot screen (consisting of a 0.01-inch slot screen). Approximately 1.5 m (5 feet) or 3 m (10 feet) of well screen was installed at each location. Annular space surrounding the well screen was filled with filter sand to 0.75 m (2.5 feet) above the top of the well screen. The remaining annular space surrounding the riser pipe consisted of bentonite seal followed by approximately 0.75 m of earth fill to the ground surface. Riser pipes at each monitoring well location extended up to approximately 1 m above ground surface and protective metal casings were installed.

A summary of the well installation details for all monitoring locations installed during the hydrogeological investigation is provided in the table below. The location of all monitoring points completed at the Site are provided on the attached Figure 2.

Table 4.2-1: Summary of Monitoring Well Locations

Monitoring Location	Easting	Northing	Ground Surface Elevation (masl)	Depth (masl)	Depth (mbgl)
MW 1	585331	4834893	273.1	265.5	7.6
MW 2	585392	4834939	273.5	265.9	7.6
MW 3S	585421	4834993	273.9	270.0	3.9
MW 3D	585421	4834993	273.9	266.3	7.6
MW 4	585374	4834859	273.3	258.1	15.2
MW 5	585420	4834903	273.8	266.2	7.6
MW 6	585492	4834931	275.0	266.2	8.8
MW 7	585426	4834824	273.4	265.8	7.6
MW 7D	585418	4834983	273.8	256.4	17.4
MW 8	585493	4834863	273.8	258.9	14.9
MW 9	585466	4834754	272.8	265.0	7.8
MW 10	585534	4834802	273.4	265.8	7.6
MW 11	585574	4834887	274.6	267.0	7.6
MW 12S	585535	4834681	270.9	266.3	4.6
MW 12D	585535	4834681	270.9	263.3	7.6
MW 13	585607	4834777	272.8	265.2	7.6
MW 14	585668	4834852	273.8	266.2	7.6

Results of water level measurements are further summarized in Section 4.3 below.

4.3 Groundwater Elevation

Observations pertaining to the depth of water level and caving were made in the open boreholes immediately after completion of drilling, and are reported on the borehole logs. Stabilized groundwater level measurements in the monitoring wells were taken on five (5) monitoring events and are are summarized in the table below.

In order to capture the seasonal groundwater fluctuations, a six (6) month groundwater monitoring program was conducted on the Site from November 2018 to November 2020. Continuous groundwater level data was obtained from all monitoring wells through the use of data loggers programmed to record water level data at a 60-minute frequency. The data loggers were programmed to record groundwater levels at 1 hour recording interval. Barologger was also programmed at 1-hour interval and installed in BH9 for barometric compensation Hydrographs of water level data collected from the data loggers are provided in Appendix J.

Table 4.3-1 Groundwater Elevation

Well ID.	Well Screen Bottom Elev. (masl)	Ground Elev. (masl)	Screen Depth (masl)	Strata	On Completion (mbgl)	Groundwater Level (mbgl/masl)				
					Unstabilized Water Level (mbgl)	Oct 19, 2018	Nov. 2, 2018	Dec. 21, 2018	May 15, 2019	Nov 11, 2020
Overburden Wells										
MW 1	265.4	273.1	265.5 – 268.5	Sandy Clayey Silt	Dry	DRY	4.18/ 268.92	0.725/ 272.38	0.35/ 272.75	-
MW 3S	269.7	273.9	270 – 271.5	Clayey Silt	Dry	DRY	2.55/ 271.35	0.22/ 273.68	0.12/ 273.78	2.33/ 271.57
MW 4	258.0	273.3	258.1 – 261.1	Clayey Silt	14.3	14.3/ 259.0	2.72/ 270.58	0.92/ 272.38	0.54/ 272.76	-
MW 5	265.9	273.8	266.2 – 269.2	Clayey Silt	Dry	DRY	4.07/ 269.73	0.59/ 273.21	0.31/ 273.49	-
MW 7	256.6	273.4	265.8 – 268.8	Clayey Silt	Dry	DRY	2.97/ 270.43	0.55/ 272.85	0.27/ 273.13	-
MW 8	259.1	273.8	258.9 – 261.9	Clayey Silt	14.0	14/ 259.8	2.85/ 270.95	0.81/ 272.99	0.52/ 273.28	-
MW 9	265.0	272.8	265 – 268	Clayey Silt	Dry	DRY	6.94/ 265.86	0.60/ 272.2	0.50/ 272.3	-
MW 10	265.6	273.4	265.8 – 268.8	Sandy Clayey Silt	Dry	DRY	4.55/ 268.85	0.82/ 272.58	0.08/ 273.32	-
MW 11	266.8	274.6	267 – 270	Sandy Clayey Silt	Dry	DRY	3.40/ 271.2	1.29/ 273.31	0.70/ 273.9	3.43/ 271.17
MW 12S	266.2	270.9	266.3 – 267.8	Gravel and Sand	Dry	DRY	DRY	3.31/ 267.59	1.93/ 268.97	-
MW 12D	263.2	270.9	263.3 – 266.3	Clayey Silt	5.8	5.8/ 265.1	4.66/ 266.24	3.51/ 267.39	2.25/ 268.65	-
MW 13	265.07	272.8	265.2 – 268.2	Clayey Silt	Dry	DRY	5.82/ 266.98	3.46/ 269.34	1.0/ 271.8	-
MW 14	266.6	273.8	266.2 – 269.2	Silt, some Sand	6.7	6.7/ 267.1	4.92/ 268.88	4.65/ 269.15	1.48/ 272.32	-

Bedrock Wells										
MW 2	265.7	273.5	265.9 – 268.9	Weathered Shale	Dry	DRY	5.06/ 268.44	0.18/ 273.32	0.10/ 273.4	2.18/ 271.32
MW 3D	266.1	273.9	266.3 – 269.3	Weathered Shale	Dry	DRY	2.39/ 271.51	0.59/ 273.31	0.22/ 273.68	2.42/ 271.48
MW 6	266.4	275.0	266.2 – 269.2	Weathered Shale	Dry	DRY	6.31/ 268.69	1.49/ 273.51	1.10/ 273.9	3.06/ 271.94
MW 7D	256.4	273.8	256.4 – 259.4	Weathered Shale	Dry	DRY	2.62/ 271.18	1.13/ 272.68	0.73/ 273.07	3.00/ 270.80

- Based on the above monitoring events, groundwater elevation within the monitoring wells installed in the overburden varies from elevation ± 273.78 masl (MW3S) located at the north corner of the Property to elevation ± 265.86 masl (MW 9) located at the southeast corner of the Property.
- Based on the above monitoring events, groundwater elevation within the monitoring wells installed in the bedrock varies from elevation ± 273.9 masl to ± 268.69 masl (MW6) located at the north corner of the Property.
- Based on the groundwater monitoring data analysed from data loggers installed at the Site for 2-year monitoring program (November 2018 - November 2020), the groundwater elevation at the Site varies from elevation ± 274.05 masl (MW3S) located at the north corner of the Property to elevation ± 266.59 masl (MW12S/D) located at the south corner of the Property indicating the groundwater flow direction towards south/southwest similar to the trend observed based on the manual groundwater monitoring events as indicated in the above table.

It should be noted that the groundwater levels noted above may fluctuate seasonally depending on the amount of precipitation and surface runoff. The till deposit below the Site is of low hydraulic conductivity and precludes the free flow of groundwater. Hydraulic gradients were determined based on the water levels obtained over the duration of the monitoring program. Vertical gradients are summarized in the attached Appendix J. Gradients at the Site based on stabilized groundwater levels were observed to be downward. Vertical hydraulic gradients at multi-level monitoring well locations MW 3 and MW 12 were calculated. Vertical gradients were calculated as downward gradients (positive) for each of the above nested monitoring wells. Vertical gradients are summarized in the table below:

Table 4.3-2 Summary of Ground Water Vertical Hydraulic Gradients

Monitoring Well	Vertical Hydraulic Gradient				
	9-Oct-18	2-Nov-18	21-Dec-18	15-May-19	11-Nov-20
MW 3	n/m	-0.04	0.10	0.03	0.02
MW 12	n/m	n/m	0.07	0.11	n/m

Based on the above measured vertical gradients at the Site it is expected that the Site serves as an area for groundwater recharge. Discharge of groundwater at the Site is not anticipated, as gradients at the Site were observed to be vertically downward. Groundwater recharge at the Site is expected to be limited

based on the low permeability soils present at the Site. Significant groundwater baseflow to surface water features is not expected at the Site.

4.4 Groundwater Quality

Terraprobe visited the Site on November 5, 2018 to collect representative groundwater samples for chemical analysis. Nine (9) groundwater samples obtained from BH 1, BH 3S, BH 5, BH 8, BH 10, BH 11, BH 12D and BH 14 and a duplicate sample were submitted for chemical analyses of nitrate/nitrite. In summary, the results are provided below:

Table 4.4-1 Summary of Ground Water Quality

Sample	Ontario Drinking Water Standard	Results (November 5, 2018)
	Nitrate (mg/L)	Nitrate (mg/L)
BH 1	10	0.079
BH 3S		3.62
BH 5		0.476
BH 8		0.286
BH 10		0.075
BH 11		1.57
BH 12D		1.18
BH 14		15.4

The laboratory certificates of analysis are provided in Appendix I.

4.5 Grain Size Analysis

The geotechnical laboratory testing consisted of water content determination on all samples, while a Sieve and Hydrometer analysis was conducted on selected native soil samples. The grain size analysis results are provided as Appendix D. A summary of the Sieve and Hydrometer (grain size) analysis is presented as follows:

Table 4.5-1 Grain Size Analysis

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)
		Gravel	Sand	Silt	Clay	
BH4/SS12	13.5 – 14 m	1.2	13.8	60.7	24.4	Clayey Silt, some sand, trace gravel
BH7/SS7	6 – 6.5 m	1.2	12.4	60.4	25.9	Clayey Silt, some sand, trace gravel
BH9/SS3	1.5 – 2 m	2.0	16.5	57.6	24.0	Clayey Silt, some sand, trace gravel
BH11/SS1	0 – 0.6 m	1.4	24.1	48.1	26.4	Sandy Clayey Silt, trace gravel

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)
		Gravel	Sand	Silt	Clay	
BH12/SS6	6 –6.5 m	37.3	46.1	11.8	4.8	Gravel and Sand, some silt, trace clay
BH14/SS7	6 – 6.5 m	0.2	19.3	63.8	16.7	Silt, some sand, some clay, trace gravel

4.6 Hydraulic Conductivity

The hydraulic conductivity of the various strata assessed based on grain size distribution testing and published data are summarized below.

Table 4.6-1 Hydraulic Conductivity

Borehole	Soil Description (MIT System)	Strata	Hydraulic Conductivity (m/s)	
			Results	Published Data
BH4/SS12	Clayey Silt, some sand, trace gravel	Clayey Silt	10^{-8}	10^{-10} to 10^{-12}
BH7/SS7	Clayey Silt, some sand, trace gravel	Clayey Silt	10^{-8}	10^{-10} to 10^{-12}
BH9/SS3	Clayey Silt, some sand, trace gravel	Clayey Silt	10^{-7}	10^{-10} to 10^{-12}
BH11/SS1	Sandy Clayey Silt, trace gravel	Sandy Clayey Silt	10^{-8}	10^{-6} to 10^{-8}
BH12/SS6	Gravel and Sand, some silt, trace clay	Gravel and Sand	10^{-4}	10^{-2} to 10^{-4}
BH14/SS7	Silt, some sand, some clay, trace gravel	Silt, some sand	10^{-6}	10^{-6} to 10^{-8}

The stratigraphy indicates low permeability across the majority of the Site. These stratigraphy units at the Site are considered to be aquitard which will preclude the free flow of water. However, there are sandy seams present along the southern edge of the Property in the vicinity of boreholes BH12 and BH14 which will allow some groundwater flow. Based on the above results, the hydraulic conductivity of clayey silt is estimated as order of 10^{-8} m/s whereas, based on the results of BH12 and BH14 the hydraulic conductivity of silt to gravel and sand layers identified on the southern portion of Site are estimated in order of 10^{-4} m/s to 10^{-6} m/s. The grain size analysis results are provided as Appendix D.

4.7 Field Testing of Hydraulic Conductivity

In-situ tests were conducted by Terraprobe on five (5) selected monitoring wells (BH1, BH3S, BH5, BH8 and BH12D) between November 2 and 5, 2018 to assess the hydraulic conductivity. The majority of the monitoring wells were installed into clayey silt deposits to assess potential dewatering requirements.

Data from the single well response tests were analysed using the Bower & Rice method. Table 4.7-1 summarizes the results of the hydraulic conductivity testing. The analysis graph for the completed rising head conductivity testing are appended in Appendix E and are summarized below:

Table 4.7-1 Summary of Hydraulic Conductivities

Monitoring Well	Strata Screened	Hydraulic Conductivity (m/s)		
		Well Response Test	Grain Size Analysis	Published Data
BH1	Sandy Silt	2.61×10^{-8}	10^{-7} to 10^{-8}	10^{-6} to 10^{-9}
BH3S	Clayey Silt	3.68×10^{-8}	10^{-7} to 10^{-8}	10^{-10} to 10^{-12}
BH5	Clayey Silt	2.08×10^{-8}	10^{-7} to 10^{-8}	10^{-10} to 10^{-12}
BH8	Clayey Silt	4.31×10^{-7}	10^{-7} to 10^{-8}	10^{-10} to 10^{-12}
BH12D	Sand some Silt	6.78×10^{-8}	10^{-4} to 10^{-6}	10^{-3} to 10^{-5}

Based on the borehole logs and in-situ field tests, the stratigraphy indicates low permeability clayey silt. Based on the in-situ single well response tests, the hydraulic conductivities of the underlying soil is expected to be around 10^{-7} m/s to 10^{-8} m/s.

5.0 DISCUSSION AND ANALYSIS

Based on the data gathered for the Hydrogeological Investigation, the following discussion and recommendations are presented for Site planning purposes.

5.1 Objectives of Water Management

The following objectives need to be taken into consideration from a hydrogeological point of view when determining how to manage storm water on-site:

- The average annual volume of water that infiltrates and recharges groundwater at the Site should be similar before and after development.
- The distribution of groundwater recharge should be similar before and after development.
- Groundwater and surface water contributions to the natural features should be maintained.

5.2 Summary of Property Hydrogeological Features

The hydrogeological functions associated with the Property were assessed based on the results of subsurface investigation completed by Terraprobe and available geological and hydrogeological information. There is considerable information available to confirm the hydrogeological features and functions associated with the Property.

The results of our study indicate that the Site hydrogeological characteristics can be summarized as follows:

- The subsurface investigation conducted at the Site indicated that the stratigraphy at the Site consists of a surficial topsoil layer, underlain by native soils. Native soil at the Site consisted of sandy clayey silt to clayey silt, which extended to the full depth of the investigation across the majority of the Site. Bedrock was encountered beneath the native soils at boreholes BH 2, BH 3D, BH 6 and BH7D at depths ranging from 269.3 masl to 268.6 masl.
- The Property is situated in a suburban/rural area of Georgetown (Glen Williams). Based on the results of the door-to-door survey, majority of the surrounding properties are on municipal water services with the possibility of some groundwater wells in the area.
- Based on the groundwater monitoring events, groundwater elevation within the monitoring wells installed in the overburden varies from elevation ± 273.78 masl (MW3S) located at the north corner of the Property to elevation ± 265.86 masl (MW 9) located at the southeast corner of the Property.
- Based on groundwater monitoring events, groundwater elevation within the monitoring wells installed in the bedrock varies from elevation ± 273.9 masl to ± 268.69 masl (MW6) located at the north corner of the Property.
- Based on the groundwater monitoring data analysed from data loggers installed at the Site for 2-year monitoring program (November 2018 - November 2020), the groundwater elevation at the Site varies from elevation ± 274.05 masl (MW3S) located at the north corner of the Property to

elevation ± 266.59 masl (MW12S/D) located at the south corner of the Property indicating the groundwater flow direction towards south/southwest similar to the trend observed based on the manual groundwater monitoring events.

- The Site is located within the watershed of the Credit River. The closest surface water body is Credit River West Branch, which is located approximately 300 m southwest of the Site. The regional groundwater flow is expected to be in a southwest direction, towards Credit River West Branch, and ultimately towards Lake Ontario. Locally, groundwater depth and flow direction may be influenced by overburden thickness and shallow bedrock outcrops.
- The results of laboratory analysis on the groundwater samples obtained from the Property indicated that the nitrate concentration in the groundwater is generally low, with the exception of BH14. The elevated nitrate concentrations in the on-site groundwater monitoring wells, are assumed to be the result of the former use of the Site for farming practices (livestock).

6.0 CONSTRUCTION DEWATERING

6.1 Proposed Development Plan

The proposed development will consist of construction of 32 detached dwellings with one level of basement in each lot. It is understood that the Site will be serviced with full municipal services for water and sewage. The Site servicing and grading plan prepared by Condeland Consulting Engineers & Project Managers dated September 2020 indicate the ground elevations of all 32 detached dwellings. The numerical modeling was conducted utilizing computer software (Slide 7.014, developed by Rocscience Inc.), utilizing the finite element modeling approach. The finite element model (FEM) for groundwater seepage indicates the short term (construction) and long term (post construction) dewatering requirements as provided below. The hydraulic parametrization of the generalized numerical model is based on the grain size analyses, field hydraulic testing and published data that incorporates the permeability of different strata encountered during investigation.

For the dewatering assessment as a result of the proposed development, the following considerations were made:

- The average ground surface elevation is considered at 274 ± masl and the shallow groundwater table for design purposes is considered at elevation of 273.9 ± masl in the northern portion and 272.3 ± masl in the southern portion.
- Proposed FFE of the basements for the proposed detached dwellings was not available at the time of this report was prepared. The lowest finished basement floor elevation is set at 3.0 mbgs and the base of excavation is set at 3.5 mbgs i.e., 270.5 masl with consideration of an additional depth to safe excavation of 1.0 m (dewatering target) i.e., 269.5 masl
- For the purpose of assessing groundwater seepage rates, the following hydraulic conductivity values were assigned:

  Native (Clayey Silt) – 10^{-8} m/s
  Native (Silt to Gravel and Sand) – 10^{-6} m/s

- As the final shoring system and construction method was unknown at this stage, a permeable shoring system is considered on all sides of the proposed basements for seepage assessment. Based on the information provided by Condeland Engineering, the average footprint area of a single dwelling is approximately 303 m^2 with anticipated construction schedule of excavating 3-4 lots at one time. For the dewatering assessment, it is considered that four (4) lots will be completed at one time.

- A trench excavation is considered for installation of each of the proposed underground services (gravity sanitary sewer, storm sewer and watermain) beneath the proposed road and boulevard. As the final shoring system and construction method was unknown at this stage, a permeable shoring system is considered to complete the trench excavations for installation of underground services. Based on the information provided by Condeland Engineering, each utility line will be completed in a separate trench excavation. It is assumed that a 100 m segment of trench

excavation will be completed per day for a respective utility line with a trench width of 2.0 m. The base of excavation of each trench is considered as 0.5 m below the lowest invert elevation of the respective utility line as provided by the client with consideration of an additional depth to safe excavation of 1.0 m (dewatering target).

- For the purpose of assessing groundwater seepage rates for the construction of the lots, two finite element models were prepared for the excavation works to take into account the hydrogeological variability across the Site. One finite element model represents the excavation works in the area of the site north of the Megan Drive which will be completed in strata composed of clayey silt material, whereas the other finite element model represents the part of excavation work in the area of the site south of the Megan Drive which will be completed in strata composed of clayey silt material and silt to sand and gravel unit identified in borehole 12, 13 and 14 during the investigation. Similar approach was used for dewatering assessment for the installation of utilities.

- Should the shoring type/methodology and the construction procedure differ from the above-noted assumptions, Terraprobe should be retained to revise the groundwater seepage assessment and update the Hydrogeological Investigation report.

6.2 Construction Dewatering Flow Rate Estimation (Extraction and Discharge) and Permit Requirements

6.2.1 Short-Term Discharge of Pumped Groundwater (Construction Dewatering)

The Ministry of the Environment, Conservation and Parks (MECP) has made changes to the requirement for Permit-to-Take-Water (PTTW) approvals for construction related activities. Under the requirements, specific construction-related water taking activities are eligible for Environmental Activity and Sector Registry (EASR). Environmental Protection Act, Ontario Regulation 63/16 REGISTRATION UNDER PART II.2 OF THE ACT – WATER TAKING includes the following two (2) categories of water taking activities eligible for EASR:

- Part II: Water Taking for Road Construction Purposes
- Part III: Water Taking for Construction Site Dewatering

6.2.1.1 Short Term Dewatering Assessment - Single Lot Basements

1. <u>4 Lot Basements (in the Lot 1 to Lot 6 area) South of Megan Drive</u>

The groundwater inflow during the construction of a single lot from the Lot1 - Lot6 area is estimated to be 34,000 L/day taking into account 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area i.e., 303 m^2 would require a total pumping rate of 8,000 L/day to remove the water over a 1-day period. As such, the total dewatering rate required for the construction of a single lot in the Lot1 - Lot6 area is calculated as follows:

$$Q = 34,000 + 8,000 \text{ L/day}$$

$$Q = 42,000 \pm \text{ L/day}$$

As indicated above, four (4) lots will be completed at one time therefore the total groundwater dewatering requirements may be up to 42,000 L/day x 4 = 168,000 L/day.

Considering only four (4) lots will be completed at one time; the total groundwater dewatering requirements may be up to 168,000 ± L/day. Given that the short-term (during construction) groundwater control would require water taking of more than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is required**.

2. 4 Lot Basements (in the Lot 7 to Lot 32 area) North of Megan Drive

The groundwater inflow during the construction of a single lot from the Lot7 - Lot32 area is estimated to be 1,000 L/day taking into account 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area i.e., 303 m^2 would require a total pumping rate of 8,000 L/day to remove the water over a 1-day period. As such, the total dewatering rate required for the construction of a single lot in the Lot7 - Lot32 area is calculated as follows:

$$Q = 1,000 + 8,000 \text{ L/day}$$

$$Q = 9,000 \pm \text{ L/day}$$

As indicated above, four (4) lots will be completed at one time, the total groundwater dewatering requirements may be up to 9,000 L/day x 4 = 36,000 L/day.

Considering only (4) lots will be completed at one time, the total groundwater dewatering requirements may be up to 36,000 ± L/day. Given that the short-term (during construction) groundwater control would require water taking of less than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is not required**.

6.2.1.2 Short Term Dewatering Assessment - Utilities Installation

1. Gravity Sanitary Sewer Installation

Gravity Sanitary Sewer Installation (100-metre length) North of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of gravity sanitary sewer (100-metre length) north of Megan Drive beneath the proposed road is estimated to be in the order of approximately 4,000 ± L/day for 100 m excavation length, considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 4,000 + 5,000 \text{ L/day}$$

$$Q = 9,000 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 9,000 ± L/day. Given that the short-term (during construction) groundwater

control would require water taking of less than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is not required**.

Gravity Sanitary Sewer Installation (100-metre length) South of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of gravity sanitary (100-metre length) south of Megan Drive beneath the proposed road is estimated to be in the order of approximately 89,500 ± L/day for 100 m excavation length, considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 89{,}500 + 5{,}000 \text{ L/day}$$

$$Q = 94{,}500 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 94,500 ± L/day. Given that the short-term (during construction) groundwater control would require water taking of more than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is required**.

2. Storm Sewer Installation

Storm Sewer Installation (100-metre length) North of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of storm sewer (100-metre length) north of Megan Drive beneath the proposed road is estimated to be in the order of approximately 3,000 ± L/day for 100 m excavation length, considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 3{,}000 + 5{,}000 \text{ L/day}$$

$$Q = 8{,}000 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 8,000 L/day. Given that the short-term (during construction) groundwater control would require water taking of less than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is not required**.

Storm Sewer Installation (100-metre length) South of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of storm sewer (100-metre length) south of Megan Drive beneath the proposed road is estimated to be in the order of approximately 79,500 ± L/day for 100 m excavation length, considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m

segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 79{,}500 + 5{,}000 \text{ L/day}$$

$$Q = 84{,}500 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 84,500 L/day. Given that the short-term (during construction) groundwater control would require water taking of more than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is required**.

3. Watermain Installation

Watermain Installation (100-metre length) North of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of watermain (100-metre length) north of Megan Drive along the boulevard is estimated to be in the order of approximately 2,500 ± L/day for 100 m excavation length, considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 2{,}500 + 5{,}000 \text{ L/day}$$

$$Q = 7{,}500 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 7,500 L/day. Given that the short-term (during construction) groundwater control would require water taking of less than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is not required**.

Watermain Installation (100-metre length) South of Megan Drive

The expected groundwater flow into a trench excavation considered for installation of watermain (100-metre length) south of Megan Drive along the boulevard is estimated to be in the order of approximately 2,000 ± L/day for 100 m excavation length considering a 50% safety factor on the groundwater inflow. An incidental 25 mm precipitation event occurring over the excavation area would require a pumping rate of 5,000 L/day to remove the water over a 1-day period from a single 100 m segment. As such, the total dewatering rate per day (considering 100 m excavation will be completed per day) at the Site is calculated as follows:

$$Q = 2{,}000 + 5{,}000 \text{ L/day}$$

$$Q = 7{,}000 \pm \text{ L/day}$$

Considering only 100 m length of trench will be completed at one time, the total groundwater dewatering requirements may be up to 7,000 L/day. Given that the short-term (during construction) groundwater control would require water taking of less than 50,000 L/day, an **Environmental Activity and Sector Registry (EASR) is not required**.

The finite element model results for each excavation are presented in Appendix L which provide details related to excavation dimension, hydrogeological conditions and dewatering assessment.

6.2.2 Long-Term Groundwater Control Requirements (Post Construction)

6.2.2.1 Long Term Dewatering Assessment - Single Lot Basements

4 Lot Basements (in the Lot 1 to Lot 6 area) South of Megan Drive

The groundwater seepage requirement into the drainage system of a single lot (in the Lot 1 to Lot 6 area) south of Megan Drive is estimated to be 10,000 L/day taking into account 50% safety factor on the groundwater inflow. Infiltration around the perimeter of the detached dwelling is also anticipated during a typical 2-year design storm event and estimated to be 1,000 L/day. As such, the long-term dewatering requirement for a single lot in the Lot1 - Lot6 area at the Site is calculated as follows:

$$Q = 10{,}000 + 1{,}000 \text{ L/day}$$

$$Q = 11{,}000 \pm \text{ L/day}$$

4 Lot Basements (in the Lot 7 to Lot 32 area) North of Megan Drive

The groundwater seepage requirement into the drainage system of a single lot (in the Lot 7 to Lot 32 area) north of Megan Drive is estimated to be 1,000 L/day taking into account 50% safety factor on the groundwater inflow. Infiltration around the perimeter of the detached dwelling is also anticipated during a typical 2-year design storm event and estimated to be 1,000 L/day. As such, the long-term dewatering requirement for a single lot in the Lot7 - Lot32 area at the Site is calculated as follows:

$$Q = 1{,}000 + 1{,}000 \text{ L/day}$$

$$Q = 2{,}000 \pm \text{ L/day}$$

Total Long-Term Dewatering (Lot 1 - Lot32)

Based on the above information, the total long-term dewatering requirement for the entire subdivision is calculated as:

$$Q = (11{,}000 \times 6) + (2{,}000 \times 26) \text{ L/day}$$

$$Q = 66{,}000 + 52{,}000 \pm \text{ L/day}$$

$$Q = 118{,}000 \pm \text{ L/day}$$

Given that the long-term (post construction) groundwater control would require water taking of more than 50,000 L/day, a **Long-Term Permit to Take Water (PTTW) will be required**.

The finite element model results for each excavation are presented in Appendix L which provide details related to excavation dimension, hydrogeological conditions and dewatering assessment.

The groundwater control requirements at the Site are summarized below:

Table 6.2-1 Groundwater control requirements

Groundwater Quantity: Short Term (Construction) – S.F. 1.5 Used								
Excavation	**Groundwater Seepage**		**25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
4 Lot Basements (in the Lot 7 to Lot 32 area) North of Megan Drive	4,000	2.78	32,000	22.22	**36,000**	25.0	**No**	**No**
4 Lot Basements (in the Lot 1 to Lot 6 area) South of Megan Drive	136,000	94.44	32,000	22.22	**168,000**	116.67	**Yes**	**No**
Gravity Sanitary Sewer Installation (100 metre length) North of Megan Drive	4,000	2.78	5,000	3.47	**9,000**	6.25	**No**	**No**
Gravity Sanitary Sewer Installation-(100 metre length) South of Megan Drive	89,500	62.16	5,000	3.47	**94,500**	65.63	**Yes**	**No**
Storm Sewer Installation (100 metre length) North of Megan Drive	3,000	2.09	5,000	3.47	**8,000**	5.56	**No**	**No**
Storm Sewer Installation (100 metre length) South of Megan Drive	79,500	55.21	5,000	3.47	**84,500**	58.68	**Yes**	**No**
Watermain Installation (100 metre length) North of Megan Drive	2,500	1.74	5,000	3.47	**7,500**	5.21	**No**	**No**
Watermain Installation (100 metre length) South of Megan Drive	2,000	1.39	5,000	3.47	**7,000**	4.86	**No**	**No**
Groundwater Quantity: Long Term (Post Construction) – S.F. 1.5 Used								
Location	**Groundwater Seepage**		**Infiltration 25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
Single Lot Basements (Lot 1 - Lot 32) Entire Subdivision	86,000	59.72	32,000	22.22	**118,000**	**81.94**	**No**	**Yes**

6.2.3 Zone of Influence (ZOI)

The Zone of Influence (ZOI) for dewatering, also known as Radius of Influence (R_0) with respect to maximum drawdown required was calculated based on the estimated groundwater taking rate and the hydraulic conductivity of the unit from which the groundwater will be taken at the Property. The ZOI was calculated using the Sichart's equation below:

Equation: $R_0 = C*dH*K^{0.5}$

Where:

C = Coefficient (3000 for Radial Flow; 1500 to 2000 for linear flow to trenches)
dH is the dewatering thickness (m)
K is the hydraulic conductivity (m/s)

As such the radius of influence from the dewatering activities is calculated for each excavation work as following

R_0 = 4.0 ± m to 8.0 ± m (Single Lot Basements)

R_0 = 3.0 ± m to 10.0 ± m (Gravity Sanitary Sewer)

R_0 = 3.0 ± m to 6.0 ± m (Storm Sewer)

R_0 = 1.0 ± m to 1.5 ± m (Watermain)

7.0 WATER BALANCE

7.1 Water Balance Equation

A water balance is the amount of water entering and leaving a control volume during a time period. Water balance is the relationship between components of hydrologic cycle and is expressed by the following equation:

P = S + R +I + IT + ET
P = Precipitation
S = Change in groundwater storage
R = Surface water storage
I = Infiltration
IT = Interception
ET = Evapotranspiration/Evaporation

Water balance depends on climatic condition, vegetation, land use, coverage area, topography and soil conditions such as texture, moisture, capacity, hydraulic conductibility, porosity and structure.

7.2 Water Budget

Water budget is the equation/water balance model to calculate the amount or flow of water in and out of a system. Water balance between each of these components can be calculated using various models. Thornthwaite is the most commonly used method and will be used to calculate the water balance in this report.

7.2.1 Water Balance for Pre-Development Conditions

A pre-development water balance for the Site was calculated based on the Site conditions detailed above. The Thornthwaite Method was used to calculate the relative balance between rainfall, evapotranspiration, infiltration and runoff. Based on this calculation a conceptual water balance was developed.

Based on the prevalent soil conditions observed at the Site and the Site topography and land use, as well as the climate conditions discussed in Section 3.8 above, the pre-development water balance for the Site has been calculated. The pre-development water balance is based upon 6.88 ha of the Site consisting of open land. Considering the climatological values for the area and an infiltration rate at the site of 122 mm/a based on the predominant soil type at the Site (value was obtained from the MOEE Table 2 and Table 3 approach in the Technical Information Requirements for Land Development Applications (1995) for sandy silt to clayey silt soils), the following pre-development water balance was calculated:

Table 7.2.1-1 Summary of Pre-Development Water Balance

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Runoff (m^3)
Undeveloped	68,840	51,561	34,764	8,605	8,192

A table showing the approach to the pre-development water balance for the Site is provided in Appendix H.

7.2.2 Predicted Change in Water Balance (Post-Development Conditions)

Development of an area affects the natural water balance of the Site. The most significant difference is the addition of impervious surfaces as type of surface cover. Impervious surfaces prevent the infiltration of water into the soils. Net effect of the construction of impervious surfaces is that most of precipitation that falls onto the impervious surfaces becomes surplus water and direct runoff. The natural permeability of the ground surface changes by reducing the current undeveloped land/ open space and vegetation at the Site and replacing part of these areas with less permeable/ impervious surfaces such as building roofs, roads, and driveways. The development will result in an increased volume of runoff and reduction in infiltration. Pre-development conditions results in approximately 8,605 m^3 of water available for infiltration to the groundwater system as mentioned in the above table.

Table 7.2.2-1 Summary of Post-Development Water Balance

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Proposed Development	68,840	51,561	20,857	5,163	25,542

In the post-development, the water balance calculations show that development has potential to reduce the natural infiltration by 5,163 m^3/a, and to increase the runoff by 17,350 m^3/a. If roof top runoff water i.e., 13,445 m^3/a is re-infiltrated through storm water management features, a total of 12,100 m^3/a of water could be available for infiltration under post-development conditions (assuming 90% of the available run-off is captured). The volume of roof run-off available is compared to the difference in infiltration between pre-development and post-development, as noted in the Table below:

Roof runoff Infiltration Deficit and Volume of Available Roof Run-off (Entire Site)

	Potential Post-Development Infiltration Deficit (m^3)	Volume of Roof Run-off Available (as 90% of the total Roof Run-off) (m^3)
Proposed Development Property	3,443	12,100

As noted, the volume of roof run-off exceeds the infiltration deficit. Approximately 28% of the effective roof runoff captured will be required to compensate the post-development infiltration deficit. This indicates that, with proper storm water management and mitigation measures, the overall infiltration rates at the Property can be maintained. The Site is located partially within a Significant Groundwater Recharge Area (SGRA). Mitigation measures, such as conventional low impact development (LID) storm water management measures, should be applied to maintain and enhance natural infiltration.

8.0 DEVELOPMENT IMPACT ASSESSMENT

8.1 Water Table Elevation

It is noted that the water table is found close to the ground surface, particularly over the northern and central portion of the Property. The Property grading, drainage measures and house siting should consider the high groundwater levels. Where possible, house basements and drainage ditches should be maintained at least 500 mm above the seasonal high-water levels. If it is necessary to establish house basements below the water table, then a gravity outlet must be provided to ensure positive drainage. The use of sump pumps must be avoided for basements below the water table, since pumps will operate frequently or continuously under these conditions.

Similarly, the base of all drainage ditches and 'dry' storm water management ponds should be maintained at least 500 mm above the water table, to ensure proper function.

8.2 Impact on Local Groundwater Uses

Existing groundwater uses in the vicinity of the Site consist of private residential wells to the north of the Site along Eighth Line. Residential subdivisions present in the vicinity of the Site are serviced using municipal water services and individual septic tank systems. As discussed earlier, wells surrounding the Site are predominately completed to depths between 10 to 30 m below grades. Wells to the north of the Site are located up-gradient of the groundwater flow at the Site. Impacts to these wells as a result of development at the Site are not anticipated. It is currently proposed to service the Site using municipal water services and sanitary and storm sewers following development. Long term impacts to the water table in the vicinity of the Site are not expected. Groundwater infiltration across the Site is currently minimal based on the low permeable soils across the Site and surrounding area.

The nearest residential wells identified in the MECP water well database and during the door-to-door survey are within 200 m to the western limits of the Site along Eighth Line. As shown on the cross-sections along both Eighth Line and Wildwood Road (Figures 5 and 6) the completed depth of wells in this area is generally around 36 m in depth. Private Wells typically obtain potable groundwater from depths greater than the predicted zone of influence for the proposed development at the Site.

8.3 Impacts to Local Surface Water Features

Through the implementation of storm water control measures at the Site, it is anticipated that impacts to surface water features at the Site can be minimized. The resulting increase in surface water run-off following development at the Site has the potential to result in increased surface water flow following a storm event which could result in increased erosion and degradation of the surface water features surrounding the Site.

Storm water management techniques can be implemented into Site planning to capture storm water run-off and allow for water quality and quantity control. Through the implementation of LID features, clean storm water can be attenuated on the Site limiting the impact of storm events on surface water features

maintaining the natural groundwater function at the Site. Storm water management ponds may be utilized to attenuate flows to surface water features.

During Site grading and construction, it is recommended that erosion control measures be implemented in the vicinity of surface water features to limit the flow of fine sediment particle to creek beds.

8.4 Impact on Water Quality

Impacts to water quality in the underlying bedrock system as a result of development are not anticipated. Low permeable soils present across the Site provide a confining layer above the bedrock system, protecting groundwater resources from potential contaminants at the surface. There are no significant aquifers or water bearing zones identified. The Site is not located in a hydrogeologically sensitive zone. No municipal wells are located in close proximity and the Site is not within a well head capture zone. Notwithstanding this, there are still some use of bedrock aquifers as a source of potable water in the area.

The development of the Site would result in the introduction of urban contaminants to the Site. During development, Site grading should be completed so that potential sources of urban contaminants are not discharged directly to surface water features at the Site such as through the use of storm water management ponds (SWMP). SWMP will provide water quality treatment prior to discharge to surface water features.

It is recommended that Site grading work to maintain, where possible, the native soils overlying the bedrock system. These soils will provide a confining layer over the underlying bedrock limited the downward migration of potential contaminants to the underlying bedrock.

9.0 DEVELOPMENT CONSIDERATIONS

9.1 Groundwater Recharge Management

The existing groundwater recharge rates at the Site are estimated at approximately 125 mm/a based on soil type observed at the Site. These recharge rates are based on the Site-specific conditions encountered at the Site. This recharge occurs in a broad or diffuse manner over the entire Site. Based on the Site inspection and soil conditions encountered during the subsurface investigation there are no significant zones of enhanced recharge.

Based on this assessment, the primary hydrogeological function at the Site is to provide limited groundwater recharge, given the low permeability of the soils. Therefore, management of groundwater recharge at the Site following development is recommended where it is feasible and should be designed using a Best Management Practice approach. It is anticipated that groundwater recharge at the Site can be maintained through the use of various LID techniques.

9.2 Opportunities and Constraints

Infiltration and groundwater flow at the Site following development will need to be addressed with respect to the hydrogeological aspects of Site development including the following:

- Preservation of groundwater recharge across the Property area (i.e., no net reduction in recharge to the underlying groundwater systems).

- Preservation of groundwater flow pathways and base flow contribution (groundwater discharge) to existing water courses.

The above objectives should be considered in conjunction with the requirements for storm water management at the Site.

The Site provides no significant groundwater recharge into the shallow groundwater system. The significant depth and low hydraulic conductivity soils will restrict any recharge to deeper zones. Based on the subsurface investigation completed at the Property, no significant enhanced zones of groundwater flow or transmission have been identified. Groundwater discharge to Credit River West Branch is not expected. Through the implementation of LID techniques designed on a Best Management Practice basis, it is anticipated that the natural groundwater function can be maintained.

9.3 Construction Constraints

The results of the subsurface investigation indicate that there is limited transmission of groundwater at the Site. The hydraulic conductivity measured from the rising head tests indicate that the shallow soils at the Site will not transmit significant amounts of groundwater.

Notwithstanding this, the proposed Site-grading plan should respect the continuity of potential higher conductivity sand and gravel (i.e., non-cohesive soils) layers, if encountered. For example, areas of large

cut or fill may cover sand layers with other types of soil, reduce their thickness, or result in their removal or truncation. This may result in a reduction in the volume of recharge or the capability of sand layers to transmit groundwater flow. Therefore, it is recommended that the thickness of any sand layers, if encountered, not be significantly diminished. This can be accomplished by backfilling excavations with similar native materials as were excavated.

The excavation of underground services across sand layers may interrupt groundwater flow. Trench backfilling operations should be carried out with materials that are similar to the materials that have been excavated. In particular, sand zones, if encountered, must not be truncated by backfilling of the trench using lower permeability materials (such as the silt till identified across the balance of the Site). The continuity of sand zones can be ensured by backfilling with native sandy material as excavated.

It is recommended that Site grading maintain overland pathways to surface water features where possible. Shallow slopes are also recommended to minimize the slope of the ground surface following development so that surface water run-off is reduced and groundwater infiltration at the Site is promoted.

As part of final design, the proposed Site grading, drainage and servicing plan should be reviewed by a groundwater engineer. The review should specifically address the requirement to maintain zones of groundwater transmission and discharge and the infiltration of storm water, as noted above.

9.4 Maintenance of Groundwater Recharge Rates

The existing groundwater recharge rates at the Site are approximately 122 mm/a. These recharge rates are based on the climate Canada data for the area. This recharge occurs in a broad or diffuse manner over the entire Site. Within the proposed development area, there are no significant local depressions or zones of enhanced recharge. Provided the overall recharge volume at the Site is maintained, the hydrogeological function on the Site will be preserved. There are no specific on-site features (such as spring or wetlands) that rely on significant groundwater input. Maintenance of recharge rates are ensured by directing clean water to these areas.

Based on the water balance calculation, the implementation of the proposed LID measures at the Property will result in maintaining and enhancing the infiltration volumes in the post development conditions.

9.5 Maintenance of the Overall Continuity of the Groundwater and Base Flow at the Site

It will be necessary to ensure that shallow groundwater flow is maintained to prevent reduction of base flow to drainage features. Generally, shallow groundwater is directed through the clayey silt deposits. Property servicing activity should be conducted in a fashion to ensure that the groundwater flow is not disrupted over the long-term. This will include application of the following mitigating measures:

- Use of native backfill materials at the Property for grading purposes. In particular, excavations should be backfilled with soils similar to the native soils to ensure continuity of groundwater flow across excavations.

- Extra depth topsoil proposed for backyards and boulevards should be the same or coarser than the existing grain size.

- Use of trench plugs to prevent drainage of shallow groundwater. Trench plugs should be installed to prevent drainage of shallow groundwater along granular bedding for services and long-term lowering of groundwater levels.

- Use of appropriate materials for Property grading purposes. Property grading should be conducted using materials of like or higher hydraulic conductivity than the materials found at the Property. Property material should not be capped with lower permeability materials which would serve to reduce groundwater recharge rates.

9.6 Site Servicing

A trench excavation is considered for installation of each of the proposed underground services (gravity sanitary sewer, storm sewer and watermain) beneath the proposed road and boulevard. The downstream gravity sewer system invert elevation at manhole MH 8A is 267.12 ± masl (approximately 7.0 mbgs) and downstream storm sewer system invert elevation at manhole HW1 is 269.72 ± masl (approximately 4.0 mbgs) which can intercept the sand and gravel identified in borehole 12 and 13, and silt and sand identified in borehole 14. Watermain along the boulevard will be installed in a trench excavation at ± 1.7 mbgs which will be completed in clayey silt unit and will not intercept the lower silt to sand and gravel layers. Based on this, the groundwater control may be required in areas with deep servicing requirements as indicated in the Section 6.

9.7 Monitoring Requirements

There will be a number of monitoring requirements to ensure the proper operation of the groundwater control system, and to ensure that there are no adverse impacts. The monitoring requirements will consist of the following:

- Visual monitoring of groundwater discharge on a daily basis. The discharge should be monitored to ensure that there is no evidence of sediment, fines, or deleterious materials in the discharge water.
- Monitoring of discharge volumes using a continuous recording flow meter. The total volume of discharge should be recorded on a daily basis.
- Monitoring of Site activities. A log of Site activities and any significant events which may affect the volume or quality of discharge should be maintained. This should include the following:
    - Description of the general depth and extent of excavation.
    - Noting of the duration and intensity of rainfall events.
    - Records of discharge duration and volumes
    - Noting of any unusual activities which may affect quality or volume of groundwater discharge.

There may be other requirements for monitoring which may be part of permits obtained for the Site. Any permit requirements must be met.

10.0 CONCLUSIONS

Based on the results of the investigation, the following conclusions are provided:

1. The Site's stratigraphy consisted of a surficial topsoil layer of 150 to 280 mm, underlain by native soil deposits, which in turn was underlain by weathered shale bedrock. The native soils at the Site consisted of sandy clayey silt to clayey silt, which extended to the full depth of investigation in all borehole locations with the exception of four (4) boreholes BH 2, BH 3D, BH 6, and BH 7D located at the northern portion of the Property. Weathered shale bedrock was encountered in boreholes BH 2, BH 3D, BH 6, and BH 7D at depths of approximately 4.6 to 6.1 m below ground surface.

2. Sand seams were noted in two boreholes locations, BH 12 at depth of approximately 1.5 to 6.1 m below the ground surface and BH 13 at depth of approximately 2.3 to 3.0 m below the ground surface. BH 12 and BH13 are located at the southern portion of the Property.

3. Based on the groundwater monitoring events, groundwater elevation within the monitoring wells installed in the overburden varies from elevation ± 273.78 masl (MW3S) located at the north corner of the Property to elevation ± 265.86 masl (MW 9) located at the southeast corner of the Property.

4. Based on the groundwater monitoring events, groundwater elevation within the monitoring wells installed in the bedrock varies from elevation ± 273.9 masl to ± 268.69 masl (MW6) located at the north corner of the Property.

5. Based on the groundwater monitoring data analysed from data loggers installed at the Site through a 2-year monitoring program (November 2018 - November 2020), the groundwater elevation at the Site varies from elevation ± 274.05 masl (MW3S) located at the north corner of the Property to elevation ± 266.59 masl (MW12S/D) located at the south corner of the Property indicating the groundwater flow direction towards south/southwest similar to the trend observed based on the manual groundwater monitoring events.

6. Vertical hydraulic gradients were calculated at nested monitoring well locations. Weak downward hydraulic gradients were observed at each nested installation across the Site. Areas of groundwater discharge were not observed during the Site inspection. The primary function of the Site is limited groundwater recharge to underlying groundwater systems due to the medium to low hydraulic conductivity of the overburden soils.

7. A review of the MECP water well database for all wells within 500 m of the Site and a door-to-door well survey was conducted. Majority of the properties in the vicinity of the Site are serviced by municipal supplied water. One Property to the west of the Site utilizes a private well for domestic use.

8. Impacts to surrounding private wells are not anticipated. Residential buildings in the vicinity of the Site to the east and south of the Site are serviced with municipal water and private on-site septic tank systems. A private well exists to the west of the Site. This well is completed within the

deep bedrock. Impacts to deeper groundwater systems as a result of Site development are not anticipated.

9. The overburden soil at the Site generally consists of low permeability clayey silt material, which will preclude/limit the flow of groundwater into the excavation. The hydraulic conductivity of the overburden soils, based on the in-situ rising head test, was between 10^{-7} to 10^{-8} m/s. For the purpose of assessing groundwater seepage volumes in the short and long term, the clayey silt native soils are given a hydraulic conductivity value of 10^{-8} m/s whereas a hydraulic conductivity of 10^{-6} m/s is considered for silt to gravel and sand unit layers encountered in borehole 12, 13 and 14 at south of Megan Drive.

10. There are no nearby surface water features within the vicinity of the Property. The Property will be serviced with municipal piped water and sanitary and storm sewers and the surrounding area is serviced provided with municipal piped water and individual septic tank systems. As such, it is not anticipated that there will be any impacts to local wells or natural features as a result of the groundwater control activities during construction.

11. The results of laboratory analysis on the groundwater samples collected at the Property indicated that the nitrate concentration in the groundwater is generally low, with the exception of BH14. The elevated nitrate concentrations in the on-site groundwater monitoring wells, are assumed to be the result of the former use of the Site for farming practices (livestock)

12. The water balance calculations show that development has potential to reduce the natural infiltration by 5,163 m^3/a, and to increase the run-off by 17,350 m^3/a. If roof top run-off water i.e., 13,445 m^3/a is re-infiltrated through storm water management features, a total of 12,100 m^3/a of water could be available for infiltration under post-development conditions (assuming 90% available of the run-off captured). Approximately 28% of the effective roof run-off captured will be required to compensate the post-development infiltration deficit. This indicates that, with proper storm water management and mitigation measures, the overall infiltration rates at the Property can be maintained.

13. The Site is located partially within a Significant Groundwater Recharge Area (SGRA). Mitigation measures such as conventional low impact development (LID) storm water management measures should be applied to maintain and enhance natural infiltration. Final design of the LID measures should be reviewed in conjunction with the storm water management plan for the Site.

14. The groundwater control requirements at the Site are summarized below:

Groundwater Quantity: Short Term (Construction) – S.F. 1.5 Used								
Excavation	**Groundwater Seepage**		**25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
4 Lot Basements (in the Lot 7 to Lot 32 area) North of Megan Drive	4,000	2.78	32,000	22.22	**36,000**	25.0	**No**	**No**
4 Lot Basements (in the Lot 1 to Lot 6 area) South of Megan Drive	136,000	94.44	32,000	22.22	**168,000**	116.67	**Yes**	**No**
Gravity Sanitary Sewer Installation (100 metre length) North of Megan Drive	4,000	2.78	5,000	3.47	**9,000**	6.25	**No**	**No**
Gravity Sanitary Sewer Installation (100 metre length) South of Megan Drive	89,500	62.16	5,000	3.47	**94,500**	65.63	**Yes**	**No**
Storm Sewer Installation (100 metre length) North of Megan Drive	3,000	2.09	5,000	3.47	**8,000**	5.56	**No**	**No**
Storm Sewer Installation (100 metre length) South of Megan Drive	79,500	55.21	5,000	3.47	**84,500**	58.68	**Yes**	**No**
Watermain Installation (100 metre length) North of Megan Drive	2,500	1.74	5,000	3.47	**7,500**	5.21	**No**	**No**
Watermain Installation (100 metre length) South of Megan Drive	2,000	1.39	5,000	3.47	**7,000**	4.86	**No**	**No**
Groundwater Quantity: Long Term (Post Construction) – S.F. 1.5 Used								
Location	**Groundwater Seepage**		**Infiltration 25 mm Design Rainfall Event**		**Total Volume**		**EASR Posting**	**PTTW**
	L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**		
Single Lot Basements (Lot 1 - Lot 32) Entire Subdivision	86,000	59.72	32,000	22.22	**118,000**	**81.94**	**No**	**Yes**

11.0 RECOMMENDATIONS

Based on the above conclusions of the hydrogeological assessment the following recommendations are made:

1. In order to maintain the natural groundwater function at the Site it is recommended to implement LID techniques. By implementing LID features at the Site under a Best Management Practice the natural groundwater function at the Site can be maintained or enhanced.
2. In addition, a test pit investigation is recommended at the proposed areas for LID measures at the Property to identify areas at the Site which would be suitable for infiltration measures.
3. Infiltration capacity of the soil within this area should be assessed by conducting saturated field permeability. The test pits should be excavated to depths of 2.0 to 2.3 m below prevailing ground surface and in-situ infiltration tests using Guelph Permeameter be conducted at selected representative locations within the upper 300-600 mm zone of the investigation depth. The information from the saturated field permeability test results will provided the soil percolation rate and assessment of hydraulic capability of the surficial soils at the Property. Infiltration testing is not completed at the Site due to weather constraints.
4. Upon completion of hydrogeological investigations at the Site it is recommended that all monitoring well installations be decommissioned by a licensed well driller in accordance with O. Reg. 903.

12.0 CLOSURE

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We trust that the above-noted information is suitable for your review. If you have any questions regarding this information, please do not hesitate to contact the undersigned.

Yours truly,

Terraprobe Inc.

Usman Arshad, M.Eng., P.Eng., PMP.
Project Manager

Samuel Oyedokun, P.Eng., PMP., QP$_{ESA}$
Associate/ Sr. Project Manager

Dr. Giorgio Garofalo, P.Geo., QP$_{ESA}$
Sr. Hydrogeologist/Sr. Project Manager

13.0 REFERENCES

1. Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991: Quaternary Geology of Ontario, Southern Sheet; Ontario Geological Survey Map 2544, scale 1:1,000,000.

2. Ontario Geological Survey 1991: Bedrock Geology of Southern Ontario, Southern Sheet; Ontario Geological Survey Map 2556, scale 1:1,000,000.

3. Surficial Geology of the Greater Toronto and Oak Ridges Moraine Area, Southern Ontario. Ministry of Northern Development and Mines, Ontario, 1997.

4. The Physiography of Southern Ontario. Third Edition. Ministry of Natural Resources. 1984.

5. Credit Valley Conservation Authority "Silver Creek Subwatershed Study, Subwatershed 11, Phase I Characterization Report" August 2002.

LIMITATIONS OF LIABILITY

This report was prepared at the request of, and for the exclusive use of **2147925 Ontario Inc c/o Condeland Engineering Limited**. and its affiliates ("the Intended User") is intended to provide an assessment of the hydrogeological conditions of the property located at, **West Half Lot 21, Concession 9 (Esquesing), Glen Williams, Ontario** (the Site). No one other than the Intended User has the right to use and rely on the work without first obtaining the written authorization of Terraprobe Inc. and 2147925 Ontario Inc c/o Condeland Engineering Limited.

Terraprobe Inc. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Terraprobe Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The assessment should not be considered a comprehensive audit that eliminates all risks of encountering hydrogeological problems. The information presented in this report is based on information collected during the completion of the hydrogeological study by Terraprobe Inc. It was based on the conditions on the Site at the time of the hydrogeological study by a review of historical information and field investigation to assess the hydrogeological conditions of the Site, as reported herein.

There is no warranty expressed or implied by this report regarding the hydrogeological conditions for the Site. Professional judgement was exercised in gathering and analysing information collected by reviewing previous reports, data provided by government and are open to public and field work investigation. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

In the event that during future work new information regarding the hydrogeological conditions of the Site is encountered, or in the event that the outstanding responses from the regulatory agencies indicate outstanding issues on file with respect to the Site, Terraprobe Inc. should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.

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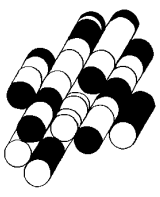
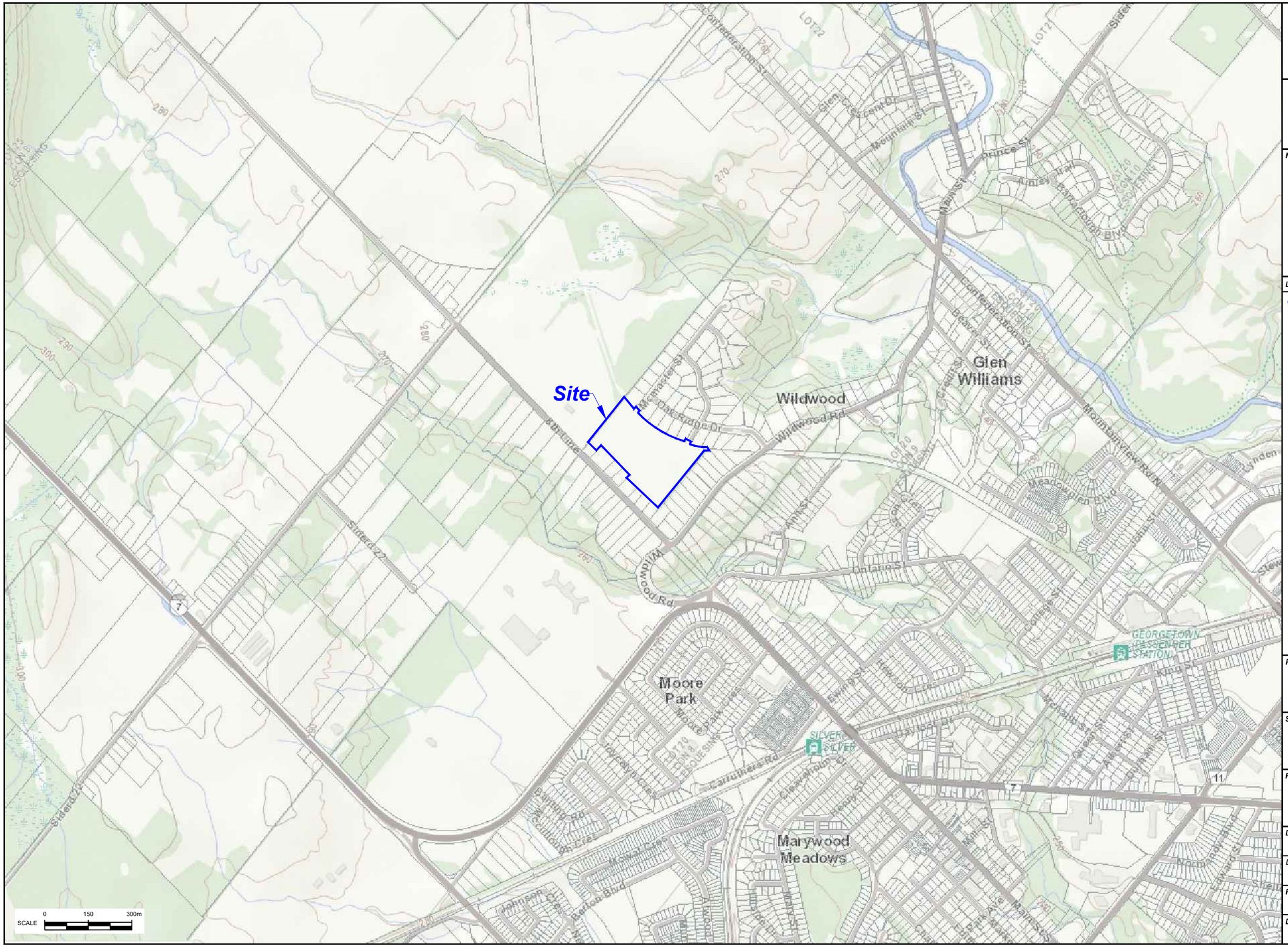
FIGURES

TERRAPROBE INC.





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Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing
11 Indell Lane - Brampton Ontario L6T 3Y3 (905) 796-2650

Reference:
Ministry of Natural Resources and Forestry
Interactive Topographic Map

Notes:

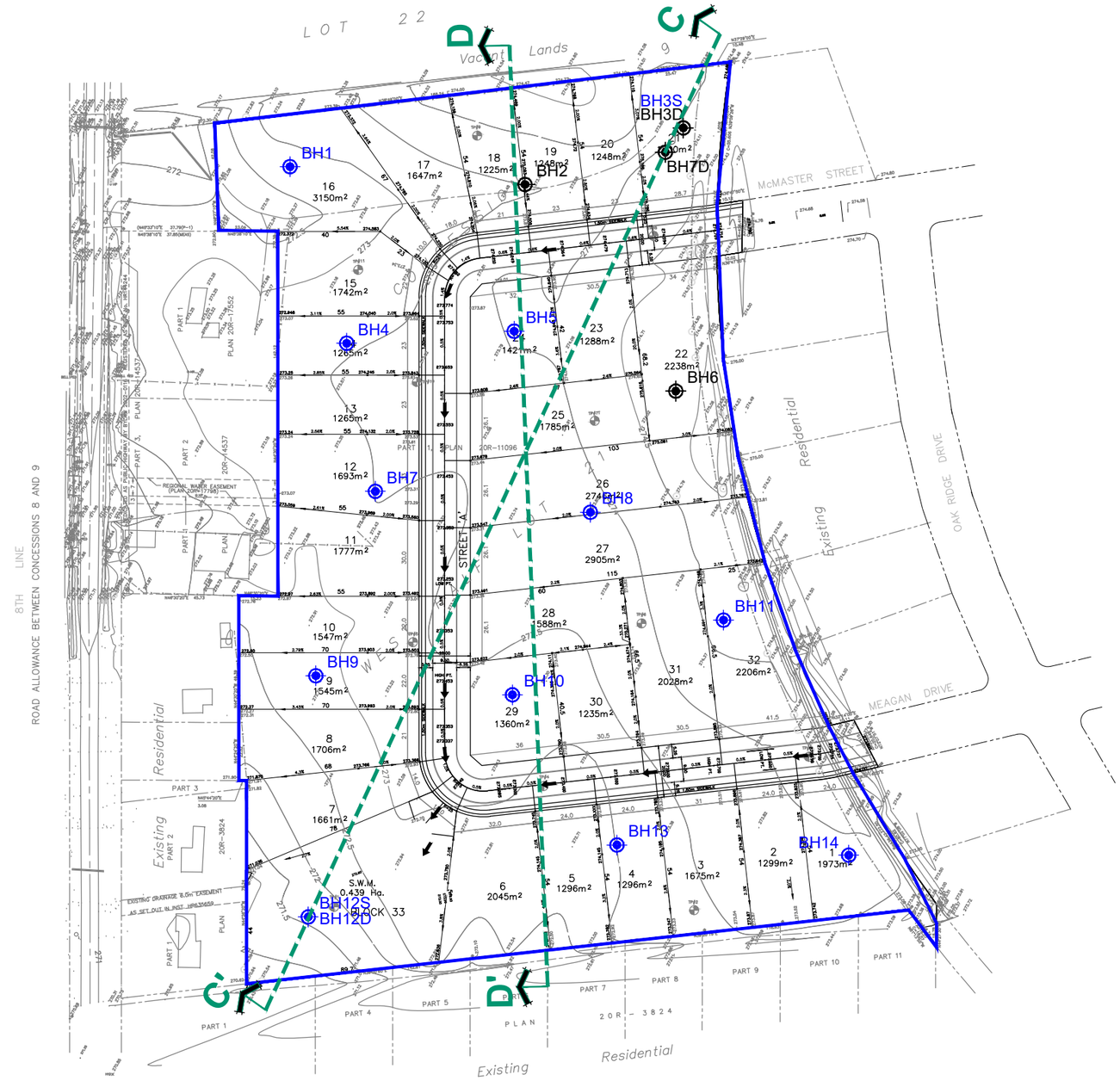
Legend:
Site Property Boundary

Project Title:
Hydrogeological Assessment

Site Location:
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:
SITE LOCATION PLAN

Designed By: KR	***File No.:*** 1-18-0438-46
Drawn By: SK	***Scale:*** As Shown
Reviewed By: SQ	***Figure No.:*** 1
Date: March 2019	



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Construction Materials, Inspection & Testing
11 Indell Lane - Brampton Ontario L6T 3Y3 (905) 796-2650

Reference:
CONCEPTUAL GRADING PLAN
Date: August 2018
By: CONDELAND
Consulting Engineers & Project Managers

Town of HALTON HILLS

Notes:

Legend:

- Site Property Boundary
- Overburden Well Location
- Bedrock Well Location
- Approximate Cross Section Location

Project Title:
Hydrogeological Assessment

Site Location:
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:
BOREHOLE / MONITORING WELL LOCATION PLAN

Designed By: KR	***File No.:*** 1-18-0438-46
Drawn By: SK	***Scale:*** As Shown
Reviewed By: SQ	***Figure No.:*** 2
Date: March 2019	

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Reference:
FIGURE 6- CONCEPTUAL GRADING PLAN
Date: September 2020
By: CONDELAND
Consulting Engineers & Project Managers

Town of HALTON HILLS

Notes:

Legend:

- Site Property Boundary
- Overburden Well Location
- 273.21 — Ground Water Level (masl), 21-Dec-2018
- Ground Water Contour Line
- Approximate Ground Water Flow Direction

Project Title:
Hydrogeological Assessment

Site Location:
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:
GROUND WATER ELEVATIONS

Designed By: KR	***File No.:*** 1-18-0438-46
Drawn By: SK	***Scale:*** As Shown
Reviewed By: SQ	***Figure No.:*** 3A
Date: March 2019	

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Reference:
FIGURE 6- CONCEPTUAL GRADING PLAN
Date: September 2020
By: CONDELAND
Consulting Engineers & Project Managers

Town of HALTON HILLS

Notes:

Legend:

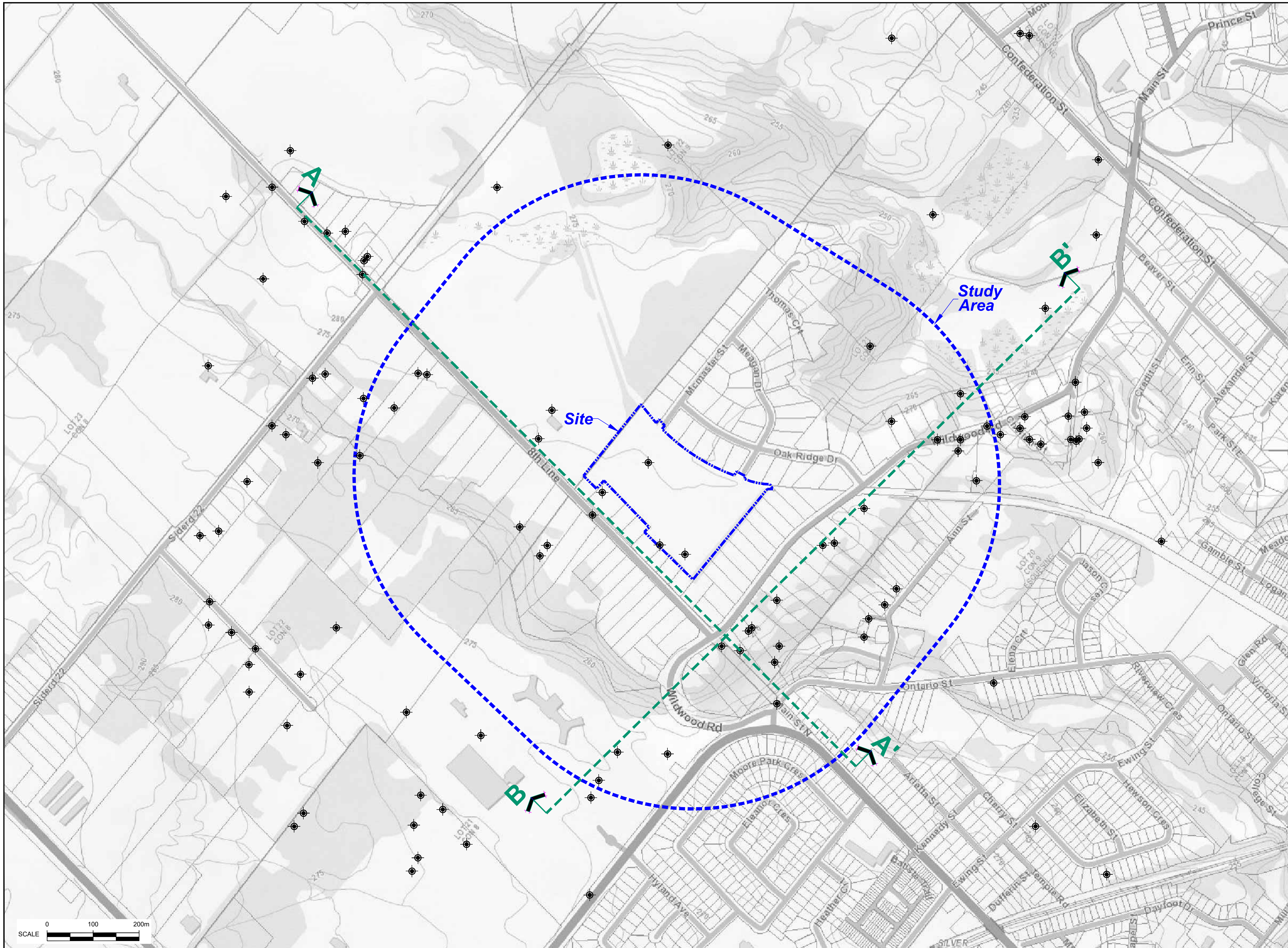
- Site Property Boundary
- Overburden Well Location
- 273.21 Ground Water Level (masl), 15-May-2019
- Ground Water Contour Line
- Approximate Ground Water Flow Direction

Project Title:
Hydrogeological Assessment

Site Location:
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:
GROUND WATER ELEVATIONS

Designed By: KR	***File No.:*** 1-18-0438-46
Drawn By: SK	***Scale:*** As Shown
Reviewed By: SQ	***Figure No.:*** 3B
Date: March 2019	



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Reference:

Ministry of Natural Resources and Forestry Interactive Topographic Map

Notes:

Legend:

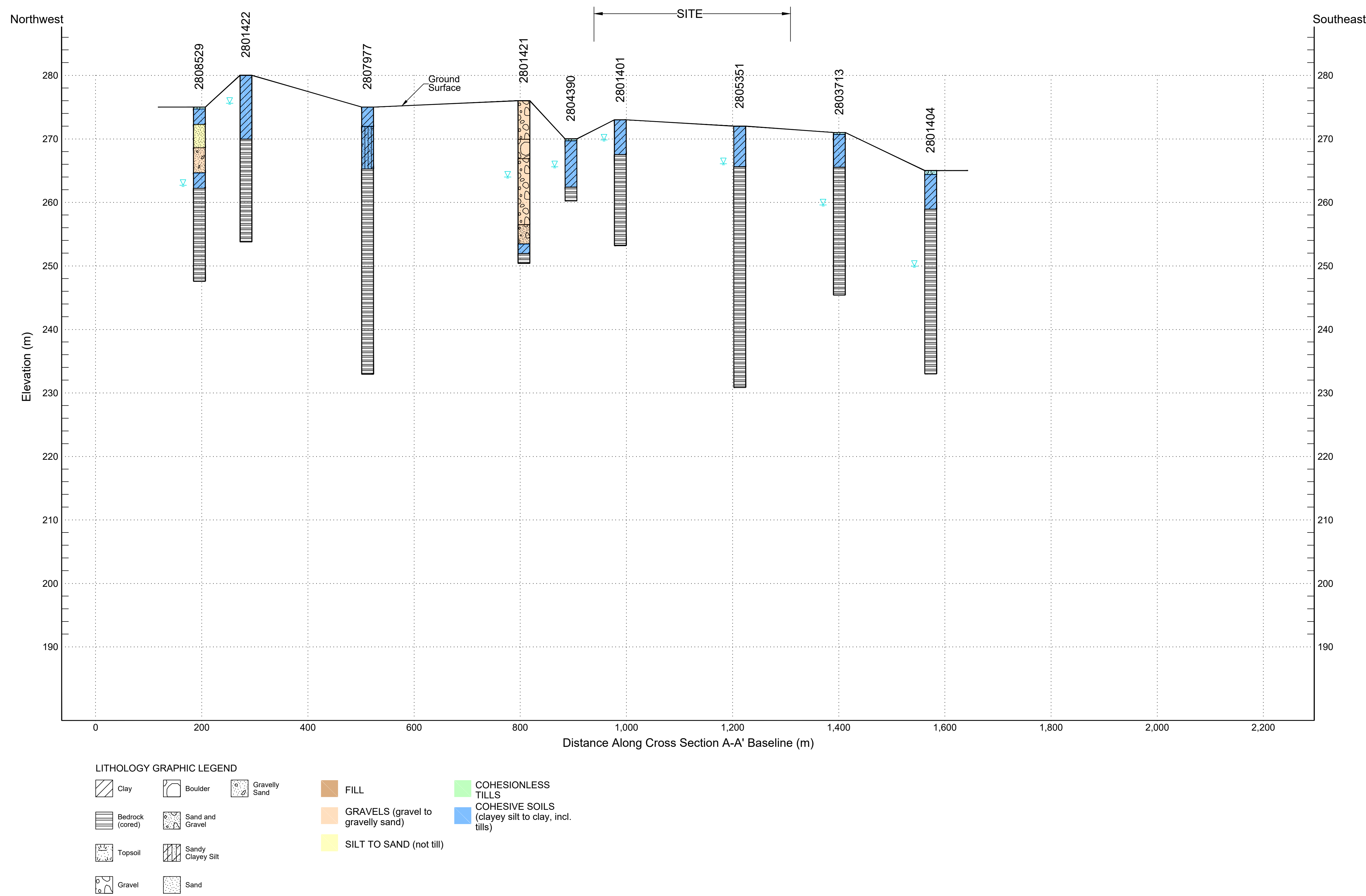
- Site Property Boundary
- Study Area, 500 m
- MECP Record Water Well Location
- Approximate Cross Section Location

Project Title: Hydrogeological Assessment

Site Location: West Half Lot 21, Concession 9 (Esquesing) Glen Williams, Ontario

Figure Title: MECP RECORD WATER WELL LOCATION PLAN

Designed By:	KR	*File No.:*	1-18-0438-46
Drawn By:	SK	*Scale:*	As Shown
Reviewed By:	SQ		
Date:	March 2019	*Figure No.:*	4



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Reference:

Notes:

Legend:

⊽	Water Level "Found At"
2803713	MECP Well Record Reference

Project Title:

Hydrogeological Assessment

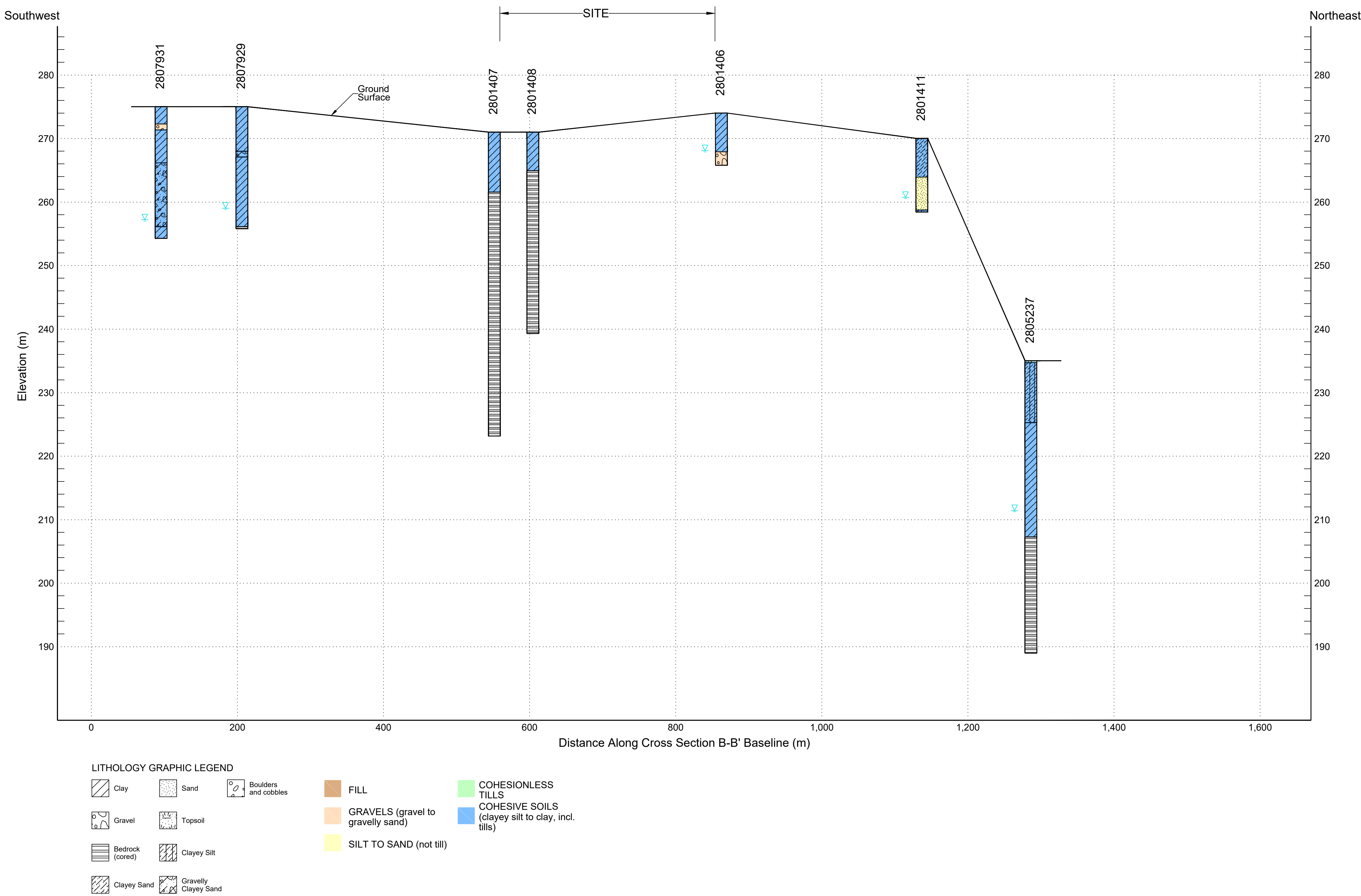
Site Location:

West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:

CROSS SECTION A-A'

Designed By: KR	*File No.:* 1-18-0438-46
Drawn By: SK	*Scale:* As Shown
Reviewed By: SQ	*Figure No.:* 5
Date: March 2019	



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Construction Materials, Inspection & Testing

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Reference:

Notes:

Legend:

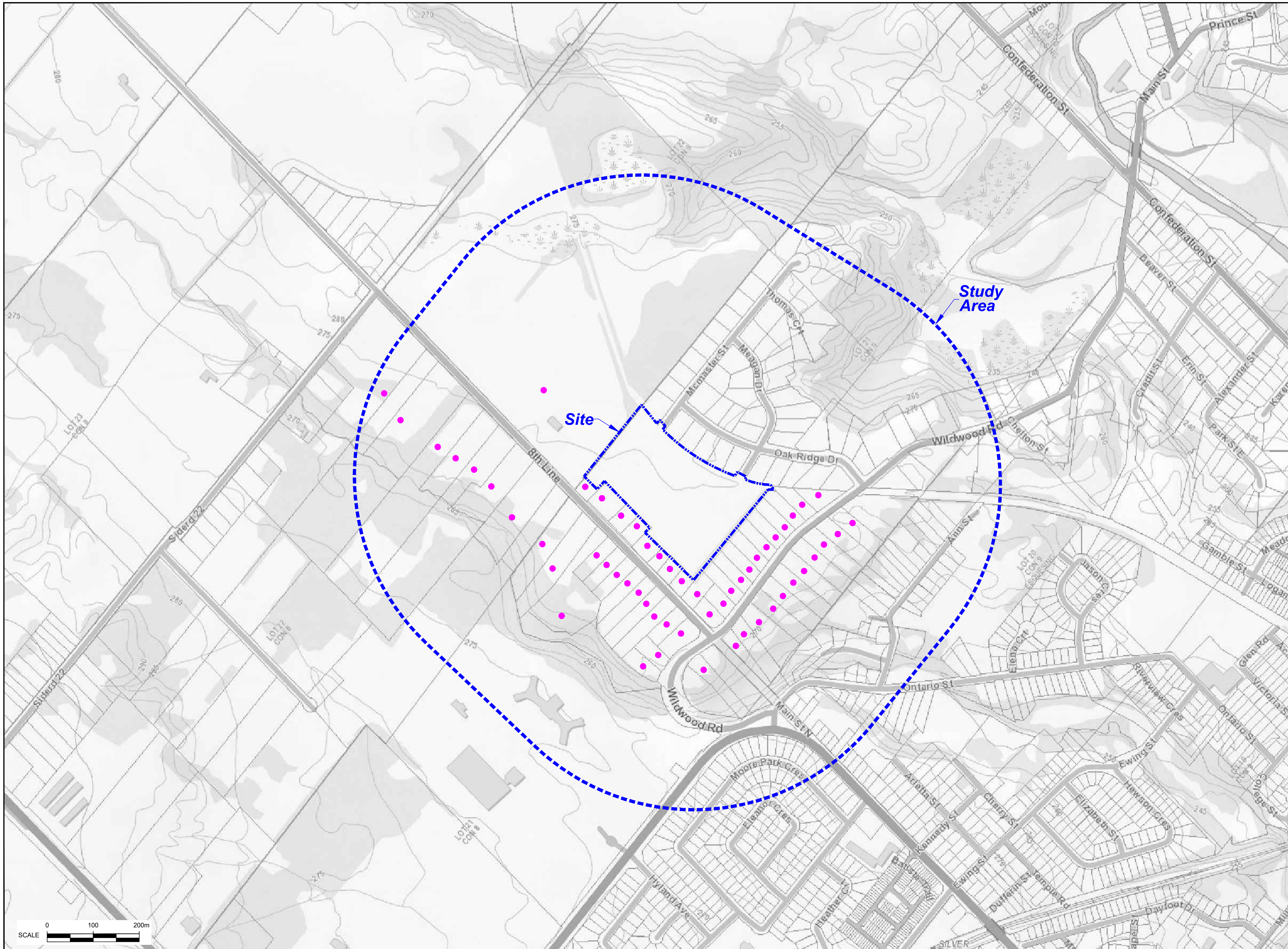
⊽	Water Level "Found At"
2801411	MECP Well Record Reference

Project Title:
Hydrogeological Assessment

Site Location:
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title:
CROSS SECTION B-B'

Designed By: KR	*File No.:* 1-18-0438-46
Drawn By: SK	*Scale:* As Shown
Reviewed By: SQ	
Date: March 2019	*Figure No.:* 6



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Construction Materials, Inspection & Testing
11 Indell Lane - Brampton Ontario L6T 3Y3 (905) 796-2650

Reference:
Ministry of Natural Resources and Forestry Interactive Topographic Map

Notes:

Legend:
- Site Property Boundary
- Study Area, 500 m
- Door-To-Door Survey Location

Project Title: Hydrogeological Assessment

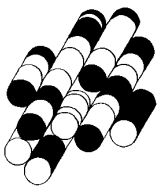
Site Location: West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, Ontario

Figure Title: DOOR-TO-DOOR SURVEY LOCATIONS

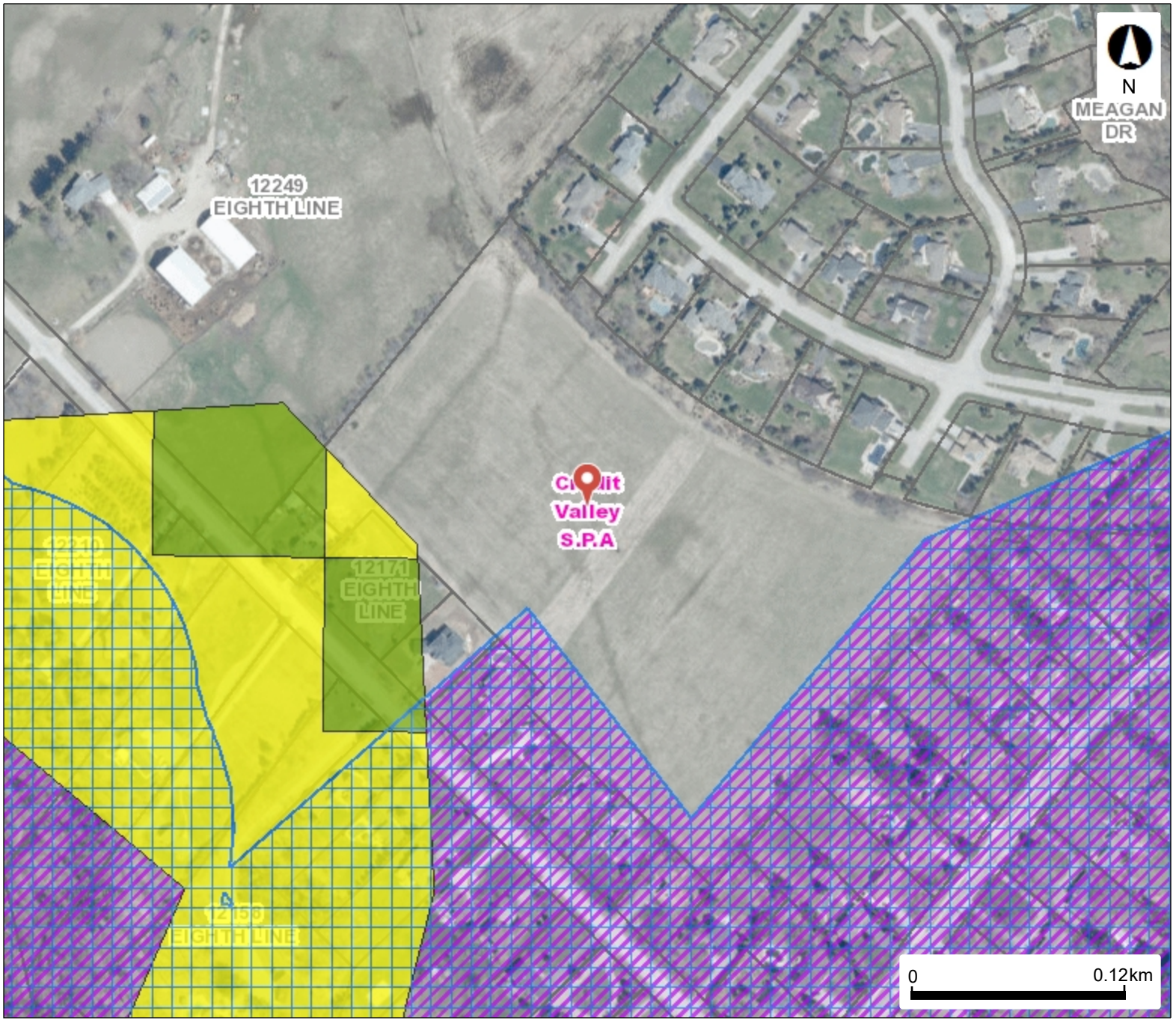
Designed By: KR	*File No.:* 1-18-0438-46
Drawn By: SK	*Scale:* As Shown
Reviewed By: SQ	
Date: March 2019	*Figure No.:* 7

APPENDIX A

TERRAPROBE INC.



Source Protection Vulnerable Areas



Legend

- Source Protection Areas
- Issue Contributing Areas
- Significant Groundwater Recharge Area
  - 0
  - 2
  - 4
  - 6
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Assessment Parcel

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

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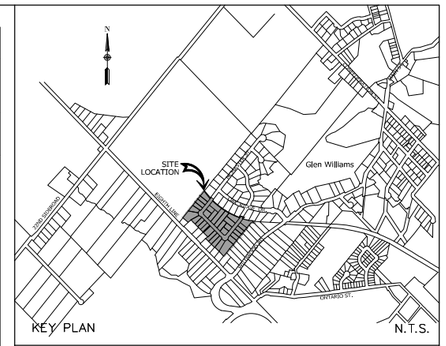
Map Created: 1/13/2021
Map Center: 43.66194 N, -79.94 W



PLAN OF SURVEY ILLUSTRATING TOPOGRAPHY
TOWN OF HALTON HILLS
REGIONAL MUNICIPALITY OF HALTON

LEGEND

- EX.200mm PVC WATERMAIN — EXISTING WATERMAIN
- EX. 50m-200mm PVC STM — EXISTING STORM DIRECTION OF FLOW
- EX. DI. — EXISTING DITCH INLET
- EX. DICB — EXISTING DITCH INLET CATCHBASIN
- EX. CB — EXISTING CATCHBASIN
- EX.DCBMH — EXISTING DOUBLE CATCHBASIN MANHOLE
- EX.MH — EXISTING STORM MANHOLE
- HYD — EXISTING HYDRANT & VALVE
- EX.HW — EXISTING HEADWALL
- V&B — EXISTING WATER VALVE & BOX
- EXISTING WATERMAIN PLUG
- 100m-200mm PVC SAN @ 1.00% — PROPOSED SANITARY SEWER DIRECTION OF FLOW
- 100m-600mm CONC STM @ 1.00% — PROPOSED STORM SEWER DIRECTION OF FLOW
- 150mm□ PVC WATERMAIN — PROPOSED WATERMAIN
- 100m-900mm CONC STM @ 1.00% — PROPOSED STORM SEWER >900mm DIRECTION OF FLOW
- DENOTES INFILTRATION GALLERY/ SOAKAWAY PIT LOCATION

- PROPOSED SANITARY SERVICE
- PROPOSED STORM SERVICE
- PROPOSED WATER SERVICE AND CURB STOP
- PROPOSED CENTERLINE/STA
- LOT LINE
- TPF TPF — SOLID TREE PROTECTION HOARDING
- MH20A — PROPOSED SANITARY MANHOLE & NUMBER
- MH20 — PROPOSED STORM MANHOLE & NUMBER
- CB — PROPOSED CATCHBASIN
- DCB — PROPOSED DOUBLE CATCHBASIN
- PCS — PROPOSED POND CONTROL STRUCTURE
- HW — PROPOSED HEADWALLS
- HYD. — PROPOSED HYDRANT & VALVE
- V&B — PROPOSED WATER VALVE & BOX

BEARINGS ARE UTM GRID, DERIVED FROM REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0)
DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.9996901.
ALL CURB ELEVATIONS ARE SHOWN TO THE TOP FACE OF CURB.
ELEVATION NOTE
ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM GEOLOGICAL SURVEY OF CANADA BENCH MARK: No. 0011954U598F
ELEVATION=258.735m, No. 0081968361 ELEVATION=252.480m
LOCAL BENCHMARK
CONCRETE NAIL LOCATED ON THE SOUTHWEST SIDE OF EIGHTH LINE, OPPOSITE MAIL BOX FOR ADDRESS No. 12124.
ELEVATION=271.26m
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED PIPE SIZES ARE IN MILLIMETRES

2	REVISED AS PER TOWN/REGION/CBC COMMENTS	MAR/24/2021	M.E.H.
1	REVISED AS PER TOWN/REGION/CBC COMMENTS	NOV/21–2019	M.E.H.
REVISION BLOCK		DATE	APPR. BY

RESIDENTIAL SUBDIVISION DEVELOPMENT
2147925 ONTARIO INC.

LICENSED PROFESSIONAL ENGINEER — M.E.HALL — MAR/24/2021 — PROVINCE OF ONTARIO

CONDELAND
CONSULTING ENGINEERS & PROJECT MANAGERS
350 Creditstone Road, Unit 200 Concord, Ontario L4K 3Z2
P: (905) 695-2096 F: (905) 695-2099

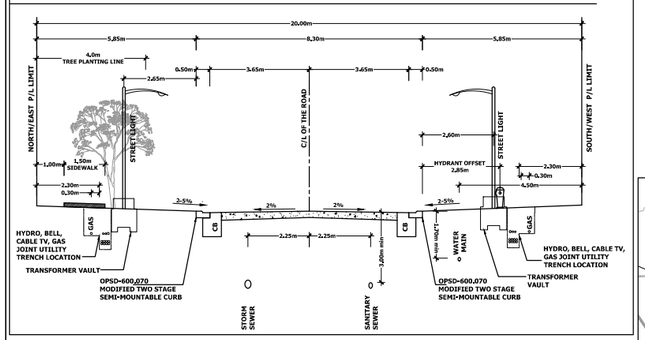
TOWN OF HALTON HILLS — Working Together Working for You!

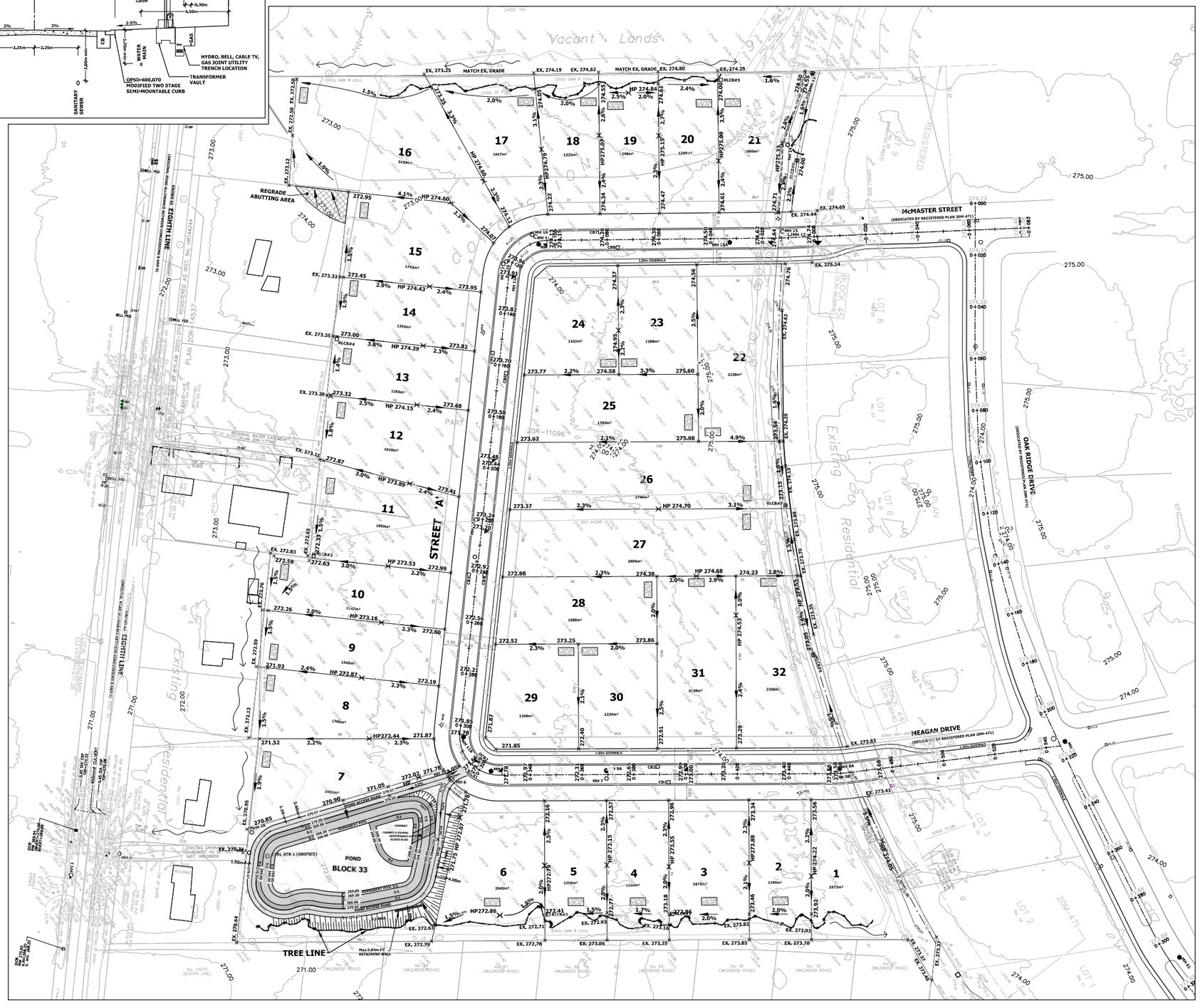
Halton REGION

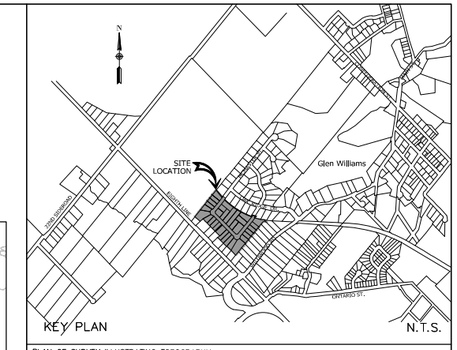
FIGURE 5 - CONCEPTUAL SERVICING PLAN

DESIGNED BY: M.E.H.	DATE: MARCH 2021	CHECKED BY: M.E.H.
DRAWN BY: A.G./V.B./G.M.	DRAWING NO. 09-015-12	CITY FILE:
SCALE HOR 1:750	Sheet: 12 OF 18	REGION FILE:

PROPOSED CROSS-SECTION DETAILS MODIFIED STD No.402
TOWN OF HALTON HILL







PLAN OF SURVEY ILLUSTRATING TOPOGRAPHY
TOWN OF HALTON HILLS
REGIONAL MUNICIPALITY OF HALTON

LEGEND

+191.84	PROPOSED ELEVATION
+ EX.191.84	EXISTING ELEVATION
HP 191.84	PROPOSED HIGH POINT ELEVATION
+ 191.84	EXISTING TOPO ELEVATION
	LOT LINE
0+000	PROPOSED CENTERLINE/STA
TPTP	SOLID TREE PROTECTION HOARDING

BEARINGS ARE UTM GRID, DERIVED FROM REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0)
DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999690.
ALL CURB ELEVATIONS ARE SHOWN TO THE TOP FACE OF CURB.
ELEVATION NOTE
ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM GEOLOGICAL SURVEY OF CANADA BENCH MARK: No. 0011954U598F ELEVATION=258.735m, No. 0081966361 ELEVATION=252.480m LOCAL BENCHMARK
CONCRETE NAIL LOCATED ON THE SOUTHWEST SIDE OF EIGHTH LINE, OPPOSITE MAIL BOX FOR ADDRESS No. 12124. ELEVATION=271.26m
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED PIPE SIZES ARE IN MILLIMETRES

REVISION	BLOCK	DATE	APPR. BY
2	REVISED AS PER TOWN/REGION/CBC COMMENTS	MAR/24/2021	M.E.H.
1	REVISED AS PER TOWN/REGION/CBC COMMENTS	NOV/21–2019	M.E.H.

RESIDENTIAL SUBDIVISION DEVELOPMENT
2147925 ONTARIO INC.

PROFESSIONAL ENGINEER
M.E.HALL
MAR/24/2021
PROVINCE OF ONTARIO

CONDELAND
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TOWN OF HALTON HILLS
Working Together Working for You!

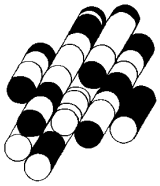
Halton REGION

FIGURE 6 - CONCEPTUAL GRADING PLAN

DESIGNED BY: M.E.H.	DATE: MARCH 2021	CHECKED BY: M.E.H.
DRAWN BY: A.G./V.B./G.M.	DRAWING NO. 09-015-13	CITY FILE:
SCALE HOR 1:750	Sheet: 13 OF 18	REGION FILE:

APPENDIX B

TERRAPROBE INC.



Water Well Records

Friday, March 15, 2019

2:12:05 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
HALTON HILLS TOWN (E CON 08 021	17 585069 4834329 W	1991/10 2604	10 10	FR 0073	53/70/3/3:0	AC	0070 5	2807934 (85835)	RED CLAY BLDR 0021 BRWN CLAY SOFT 0024 BLUE CLAY DNSE 0034 WHIT CLAY STNS 0053 GREY CLAY 0071 GREN SHLE STNS FCRD 0074 RED SHLE HARD 0075
HALTON HILLS TOWN (E CON 08 021	17 585198 4834720 W	1958/04 4838	7 7	FR 0042 FR 0065 FR 0088	11/55/6/2:0	DO		2801260 ()	LOAM 0002 CLAY STNS 0008 RED SHLE 0096
HALTON HILLS TOWN (E CON 08 021	17 585214 4834743 W	1969/04 3512	6 6	FR 0052	18/95/1/3:0	DO		2803283 ()	LOAM 0001 RED CLAY 0030 RED CLAY SHLE 0050 RED SHLE 0112
HALTON HILLS TOWN (E CON 08 021	17 585326 4834230 W	2003/05 2604				NU		2809752 (264471) A	
HALTON HILLS TOWN (E CON 08 021	17 585476 4834288 W	1950/11 4838	5 5	FR 0082	30//4/:	DO		2801259 ()	RED CLAY 0020 RED SHLE 0082
HALTON HILLS TOWN (E CON 08 021	17 584938 4834198 W	1992/09 2604	5	FR 0052	45//30/2:0	AC	0050 2	2808016 (85862)	RED CLAY STNS GRVL 0010 GREY STNS HARD LOOS 0031 BRWN CLAY 0036 BRWN SAND CGRD 0041 GREY STNS CLAY 0047 GREY GRVL STNS CLAY 0052 RED SHLE STNS LYRD 0053
HALTON HILLS TOWN (E CON 08 021	17 584986 4834167 W	1990/10 2604	10 10	FR 0066	47/51/129/72:0	DO	0056 11	2807683 (88822)	GREY BLDR CLAY HARD 0012 WHIT BLDR GRVL STNS 0020 YLLW CLAY STNS PCKD 0031 GREY CLAY STNS PCKD 0039 YLLW CLAY STNS SNDY 0041 GREY PGVL STNS LOOS 0045 GREY STNS CLAY LYRD 0050 RED BLDR STNS WBRG 0055 WHIT BLDR STNS WBRG 0058 GREY GRVL CLAY PCKD 0061 WHIT STNS GRVL SHLE 0066 RED SHLE DNSE 0067
HALTON HILLS TOWN (E CON 08 021	17 585367 4834292 W	1991/12 2604	2 2	FR 0061	53/58/1/1:0		0058 5	2807929 (88850)	RED CLAY STNS 0023 GREY CLAY GRVL 0026 YLLW CLAY SOFT SOFT 0031 YLLW CLAY STNS 0034 YLLW CLAY SOFT 0042 GREY CLAY SOFT 0050 YLLW CLAY SLTY 0054 RED CLAY STNS 0057 YLLW CLAY SOFT 0059 RED CLAY STNS SHLE 0062 RED SHLE 0063
HALTON HILLS TOWN (E CON 08 021	17 585309 4834193 W	1991/11 2604	5 5	FR 0066	59/64/1/2:0		0065 3	2807931 (85838)	RED CLAY STNS 0009 WHIT STNS 0012 RED CLAY STNS 0028 YLLW CLAY STNS 0029 WHIT STNS CLAY GVLY 0062 GREY STNS CLAY LYRD 0068
HALTON HILLS TOWN (E CON 08 021	17 584907 4834379 W	1991/10 2604	6 6			NU		2807933 (85836)	GREY CLAY STNS 0010 BRWN BLDR STNS LOOS 0022 GREY CLAY DNSE 0041 WHIT CHRT GRVL PCKD 0054 RED CLAY STNS 0056 YLLW CLAY 0058 GREY CLAY 0065 RED CLAY STNS 0066 RED CLAY SHLE 0073
HALTON HILLS TOWN (E CON 08 022	17 585154 4834783 W	1973/10 1660	5 5	FR 0030	15/30/4/1:0	DO		2804390 ()	BRWN LOAM 0001 RED CLAY BLDR 0025 RED SHLE 0028 RED SHLE 0032
HALTON HILLS TOWN (E CON 08 022	17 584814 4835063 W	1982/09 3637	30 24	FR 0012 FR 0021	8/20/8/0:0	DO		2806008 ()	BRWN LOAM 0001 BRWN CLAY STNS PCKD 0011 RED SHLE LYRD HARD 0023
HALTON HILLS TOWN (E CON 08 022	17 584932 4835118 W	1992/03 2336	6			DO		2807977 (109845)	BRWN CLAY STNS 0010 BRWN CLAY SAND 0032 RED SHLE 0055 BLUE SHLE 0070 RED SHLE 0138

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
HALTON HILLS TOWN (E CON 08 022	17 584952 4835115 W	1992/04 2336	6 6	SA 0180		DO		2807984 (117473)	BRWN CLAY STNS 0020 GREY CLAY STNS 0034 RED SHLE 0060 BLUE SHLE 0075 RED SHLE 0200
HALTON HILLS TOWN (E CON 08 022	17 584754 4834563 W	1970/04 4805	5	FR 0045 FR 0063	12/15/3/2:0	DO		2803397 ()	BRWN CLAY BLDR 0019 RED SHLE 0065
HALTON HILLS TOWN (E CON 08 022	17 584881 4835042 W	1997/06 1660	6 6	FR 0030	17/101/5/1:0	DO		2808779 (74946)	BLCK LOAM 0001 RED CLAY 0012 RED CLAY STNS 0020 RED SHLE 0106
HALTON HILLS TOWN (E CON 08 022	17 584805 4834939 W	1992/03 2336	6 6	SA 0110	26/85/10/1:0	DO		2807976 (109846)	BRWN CLAY STNS 0018 RED SHLE FCRD 0045 BLUE SHLE 0060 RED SHLE 0100 BLUE SHLE FCRD 0110
HALTON HILLS TOWN (E CON 08 023	17 584821 4835371 W	1988/09 5206	6	FR	81///1:20	DO		2807335 (49153)	BRWN LOAM 0002 BRWN SAND GRVL STNS 0055 BRWN GRVL STNS 0086 RED SHLE 0098 BLUE SHLE 0102 RED SHLE 0140
HALTON HILLS TOWN (E CON 08 023	17 584815 4835363 W	1987/10 3132	6	FR 0065	10/75/7/1:30	DO		2806803 (09054)	BRWN CLAY BLDR PCKD 0013 RED CLAY STNS PCKD 0017 RED SHLE WBRG HARD 0078
HALTON HILLS TOWN (E CON 09 020	17 586114 4834973 W	1976/07 3637	30 32 18	FR 0025	23/42/30/2:0	DO		2804989 ()	BRWN LOAM 0001 BRWN CLAY 0019 BRWN MSND FGVL CGVL 0043
HALTON HILLS TOWN (E CON 09 020	17 586064 4834973 W	1976/07 3637	30 32 18 18	FR 0022 FR 0029	25/41/12/1:0	DO		2804988 ()	BRWN LOAM 0001 BRWN CLAY 0015 BRWN MSND FSND 0023 BRWN CLAY STNS 0029 BRWN FSND MSND 0041
HALTON HILLS TOWN (E CON 09 020	17 586109 4834948 W	1972/05 3637	30	FR 0013	8/20/14/1:0	DO		2804129 ()	BLCK LOAM 0001 BRWN SAND MUCK 0003 BRWN CLAY 0013 BRWN CSND GRVL 0016 GREY CLAY SAND 0023
HALTON HILLS TOWN (E CON 09 021	17 585434 4834923 W	1967/08 1325	30	FR 0030	15/29/1/0:30	ST DO		2801412 ()	LOAM 0001 BRWN CLAY BLDR 0012 RED SHLE 0032
HALTON HILLS TOWN (E CON 09 021	17 585839 4834748 W	1961/07 1325	30	FR 0020	20///:	DO		2801406 ()	BRWN CLAY MSND 0020 GRVL 0027
HALTON HILLS TOWN (E CON 09 021	17 585634 4834513 W	1961/10 4101	5					2801407 () A	RED CLAY 0031 RED SHLE 0157
HALTON HILLS TOWN (E CON 09 021	17 585659 4834563 W	1962/04 4101	5					2801408 () A	BRWN CLAY 0020 RED SHLE 0104
HALTON HILLS TOWN (E CON 09 021	17 585654 4834558 W	1962/04 4101	5 5	FR 0054	30/58/3/5:0	DO		2801409 ()	BRWN CLAY 0030 RED SHLE 0071
HALTON HILLS TOWN (E CON 09 021	17 585714 4834398 W	1956/08 4838	6 6	FR 0080	50/105/4/1:30	DO		2801404 ()	LOAM 0002 CLAY GRVL 0020 RED SHLE 0105
HALTON HILLS TOWN (E CON 09 021	17 585709 4834488 W	1956/06 4838	6 6	FR 0035 FR 0048	12/53/4/1:30	DO		2801402 ()	GRVL STNS CLAY 0015 RED SHLE 0053
HALTON HILLS TOWN (E CON 09 021	17 585104 4835523 W	1962/09 1613	4					2801410 () A	PRDG 0040 RED SHLE 0122
HALTON HILLS TOWN (E CON 09 021	17 585334 4834858 W	1952/07 4838	5 5	FR 0065	11/22/5/1:30	DO		2801401 ()	CLAY 0018 RED SHLE 0065
HALTON HILLS TOWN (E CON 09 021	17 585964 4835013 W	1964/05 1325	30	FR 0031	31/36/1/1:0	DO		2801411 ()	BRWN CLAY MSND 0020 BRWN MSND 0037 RED CLAY MSND 0038

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
HALTON HILLS TOWN (E CON 09 021	17 585459 4834743 W	1960/10 4838	6 6	FR 0042 FR 0063 FR 0085 FR 0106	21/106/2/1:0	DO		2801405 ()	RED CLAY 0005 RED SHLE 0111
HALTON HILLS TOWN (E CON 09 021	17 585714 4834623 W	1970/04 3637	30 32 22	FR 0016 FR 0041	15/40//:	DO		2803357 ()	BRWN CLAY MSND STNS 0010 BRWN MSND GRVL 0022 BRWN CLAY STNS 0042
HALTON HILLS TOWN (E CON 09 021	17 585313 4834809 W	2002/10 4868				ST		2809658 (207081) A	
HALTON HILLS TOWN (E CON 09 021	17 585313 4834809 W	2002/10 4868				DO		2809657 (207080) A	
HALTON HILLS TOWN (E CON 09 021	17 585917 4835177 L	1988/09 3372			20/20/25/3:30			2807157 (31529)	BLCK LOAM 0010 SAND 0030 RED SHLE 0040 RED SHLE 0056
HALTON HILLS TOWN (E CON 09 021	17 585514 4834723 W	1978/07 4320	6 6	FR 0120	20/20/3/1:0	DO		2805351 ()	RED CLAY GRVL 0021 RED SHLE 0135
HALTON HILLS TOWN (E CON 09 021	17 586114 4835073 W	1976/08 4320	6 6	FR 0151	78/78/1/1:0	DO		2805237 ()	BRWN LOAM 0001 BRWN SILT CLAY 0032 GREY CLAY STNS 0091 RED SHLE 0151
HALTON HILLS TOWN (E CON 09 021	17 585594 4834523 W	1971/07 1660	6	FR 0080	38/70/6/1:0	DO		2803713 ()	BLCK LOAM 0001 BRWN CLAY STNS 0018 RED SHLE 0084
HALTON HILLS TOWN (E CON 09 021	17 585904 4834823 W	1972/02 3637	30	FR 0023	8/24/14/1:0	DO		2804110 ()	BRWN LOAM 0001 BRWN SAND GRVL 0016 GREY CLAY 0023 GREY SAND 0028
HALTON HILLS TOWN (E CON 09 021	17 585814 4834743 W	1968/10 1307	30	FR 0045	45///:	DO		2802959 ()	BRWN LOAM MSND 0020 GREY CLAY 0045 GRVL 0047 GREY CLAY 0065
HALTON HILLS TOWN (E CON 09 021	17 585514 4834723 W	1976/11 4602	6	FR 0042 FR 0065	12/63/5/1:0	DO		2804957 ()	PRDG 0027 RED SHLE 0069
HALTON HILLS TOWN (E CON 09 022	17 585224 4835037 W	1994/11 1565	6 6	FR 0094 FR 0116	22/64/3/4:0	DO		2808318 (131916)	LOAM 0001 BRWN CLAY 0019 RED SHLE 0116
HALTON HILLS TOWN (E CON 09 023	17 585195 4834975 W	1963/05 4101	6 6	SA 0084	40/80/4/5:0	DO		2801421 ()	GRVL 0020 BLDR 0030 GRVL 0064 GRVL MSND 0074 RED CLAY 0079 RED SHLE 0084
HALTON HILLS TOWN (E CON 09 023	17 584774 4835427 W	1996/09 1660	6 6	FR 0083	41/87/2/1:0	DO		2808529 (74939)	BLCK LOAM 0001 BRWN CLAY STNS 0009 BRWN SAND 0021 BRWN SAND GRVL 0034 BRWN CLAY SLTY 0042 RED SHLE 0090
HALTON HILLS TOWN (E CON 09 024	17 584811 4835333 W	1964/10 4838	6 6	FR 0036 FR 0065 FR 0082	15/55/8/2:0	IR		2801422 ()	BLUE CLAY 0033 RED SHLE 0086
HALTON HILLS TOWN (G	17 585974 4834648 W	1958/04 4838	6 6	FR 0056 FR 0063 FR 0065	7/68/4/1:30	DO		2801667 ()	CLAY 0028 CLAY 0036 GRVL 0040 RED SHLE 0068
HALTON HILLS TOWN (G	17 586054 4835463 W	1962/10 1309	7 7	FR 0022	9/12/2/4:0	DO		2801681 ()	BLCK LOAM 0001 BRWN CLAY MSND 0012 GREY CLAY SILT 0021 GRVL CLAY 0024

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
HALTON HILLS TOWN (G	17 585719 4834523 W	1957/07 4838	6 6	FR 0042 FR 0054 FR 0060	20/35/2/3:0	DO		2801661 ()	CLAY 0010 CLAY STNS 0020 RED SHLE 0062
HALTON HILLS TOWN (G	17 585904 4834543 W	1958/04 4838	6 6	FR 0042 FR 0062	8/65/3/1:30	DO		2801664 ()	CLAY GRVL 0025 RED SHLE 0065
HALTON HILLS TOWN (G	17 585914 4834583 W	1958/04 4838	6 6	FR 0054 FR 0063	10/65/3/2:0	DO		2801665 ()	CLAY GRVL 0034 MSND 0036 RED SHLE 0065
HALTON HILLS TOWN (G	17 585949 4834613 W	1958/04 4838	6 6	FR 0054 FR 0063	11/65/3/2:0	DO		2801666 ()	CLAY GRVL 0031 CLAY 0041 RED SHLE 0065

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

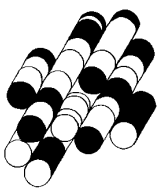
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX C

TERRAPROBE INC.



LOG OF BOREHOLE 1

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 16, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585331, N: 4834893 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	273.1	**GROUND SURFACE**					
0	272.9	150mm **TOPSOIL**					273
	0.2	**SANDY CLAYEY SILT**, compact, red, damp		1	SS	12	
	272.3						
1	0.8	**CLAYEY SILT**, very dense, red, damp		2	SS	78 / 275mm	272
				3	SS	50 / 100mm	
2							271
				4	SS	50 / 100mm	
3	270.1						270
	3.0	**SANDY CLAYEY SILT**, trace shale fragments, very dense, red, damp		5	SS	50 / 125mm	
4							269
		...at 4.6 m, grey trace red		6	SS	50 / 25mm	
5							268
6		...at 6.1 m, red		7	SS	50 / 75mm	267
7							266
	265.4			8	SS	50 / 125mm	
	7.7	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m)
Dynamic Cone 10 20 30 40
Undrained Shear Strength (kPa)
Unconfined, Pocket Penetrometer, Field Vane, Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit, Natural Water Content, Liquid Limit
PL MC LL
10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

...at 4.6m, auger grinding to 6.1m

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	4.2	269.0
Dec 21, 2018	0.7	272.4

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 2

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 16, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585392, N: 4834939 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	273.5	**GROUND SURFACE**				
	273.3	180mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, loose, red / brown, moist		1	SS	9
	272.7					
1	0.8	**CLAYEY SILT**, some sand, very dense, red to grey, damp		2	SS	72
		...at 1.5 m, shale fragments, very dense, grey		3	SS	50 / 150mm
2		...at 2.3 m, red		4	SS	50 / 125mm
3				5	SS	50 / 150mm
4	268.9					
	4.6	**WEATHERED SHALE**, very dense, grey, damp		6	SS	50 / 50mm
5						
6				7	SS	50 / 75mm
7	265.8			8	SS	50 / 100mm
	7.7	**END OF BOREHOLE**				

Elevation Scale (m): 273, 272, 271, 270, 269, 268, 267, 266

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	5.1	268.4
Dec 21, 2018	0.2	273.3

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 3

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 16, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585421, N: 4834993 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
273.9	**GROUND SURFACE**				
273.7	230mm **TOPSOIL**				
0.2	**SANDY CLAYEY SILT**, compact, dark brown, moist		1	SS	11
273.1					
0.8	**CLAYEY SILT**, some sand, trace gravel, compact, brown, moist		2	SS	28
272.4					
1.5	**SANDY CLAYEY SILT**, trace gravel, dense, brown, moist		3	SS	48
271.6					
2.3	**CLAYEY SILT**, some sand, trace shale fragments, very dense, red, damp		4	SS	73
			5	SS	50 / 125mm
269.3					
4.6	**WEATHERED SHALE**, very dense, red, damp		6	SS	50 / 50mm
			7	SS	50 / 75mm
266.2			8	SS	50 / 125mm
7.7	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

W1 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	2.6	271.4
Dec 21, 2018	0.2	273.7

W2 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	2.4	271.5
Dec 21, 2018	0.6	273.3

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 17, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585374, N: 4834859 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	273.3	**GROUND SURFACE**					273
	273.1	200mm **TOPSOIL**					
	0.2	**SANDY CLAYEY SILT**, trace gravel		1	SS	12	
	272.5						
1	0.8	**CLAYEY SILT**, some sand, very dense, red, damp		2	SS	63	272
	271.8						
	1.5	**SANDY CLAYEY SILT**, very dense, red, damp		3	SS	50 / 150mm	
2				4	SS	50 / 150mm	271
3				5	SS	50 / 125mm	270
4				6	SS	50 / 50mm	269
5							268
6				7	SS	50 / 125mm	267
7							266
8				8	SS	50 / 125mm	
9	264.2						265
	9.1	**CLAYEY SILT**, some sand, trace gravel, very dense, red with grey, damp		9	SS	50 / 100mm	264
10							263

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

(continued next page)

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 17, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 2 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585374, N: 4834859 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description (continued)	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
11		**CLAYEY SILT**, some sand, trace gravel, very dense, red with grey, damp *(continued)*		10	SS	50 / 100mm	262					
12		...at 12.2 m, dry		11	SS	50 / 75mm	261					
13							260					
14		...at 13.7 m, wet		12	SS	50 / 75mm	259					1 14 61 24 ...at 13.7m, spoon wet
15	258.1 15.2											

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) 10, Natural Water Content (MC) 20, Liquid Limit (LL) 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 14.3 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	14.3	259.0
Nov 2, 2018	2.7	270.5
Dec 21, 2018	0.9	272.3

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 5

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 17, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585420, N: 4834903 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	273.8	**GROUND SURFACE**				
	273.6	200mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, trace rootlets, loose, brown, moist		1	SS	9
	273.0					
1	0.8	**CLAYEY SILT**, some sand, trace shale fragments, very dense, red, damp		2	SS	65
				3	SS	83
2				4	SS	50 / 150mm
3				5	SS	50 / 125mm
4				6	SS	50 / 100mm
5				7	SS	50 / 100mm
6				8	SS	50 / 75mm
7	266.1					
	7.7	**END OF BOREHOLE**				

Elevation Scale (m): 273, 272, 271, 270, 269, 268, 267

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	4.1	269.7
Dec 21, 2018	0.6	273.2

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 6

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 17, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585492, N: 4834931 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	275.0	**GROUND SURFACE**				
	274.7	280mm **TOPSOIL**				
	0.3	**SANDY CLAYEY SILT**, trace gravel, loose, brown, moist		1	SS	9
1		...at 0.8 m, dense, brown, damp		2	SS	34
		...at 1.5 m, moist		3	SS	46
2		...at 2.3 m, very dense		4	SS	67 / 275mm
3		...at 3.0 m, red, damp		5	SS	50 / 125mm
4				6	SS	50 / 125mm
5						
6	268.9					
	6.1	**WEATHERED SHALE**, very dense, red, damp		7	SS	50 / 50mm
7						
				8	SS	50 / 125mm
8						
9	265.8			9	SS	50 / 100mm
	9.2	**END OF BOREHOLE**				

Elevation Scale (m): 274, 273, 272, 271, 270, 269, 268, 267, 266

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL, MC, LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

...at 6.1m, auger grinding to 7.6m

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	6.3	268.7
Dec 21, 2018	1.5	273.5

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 7

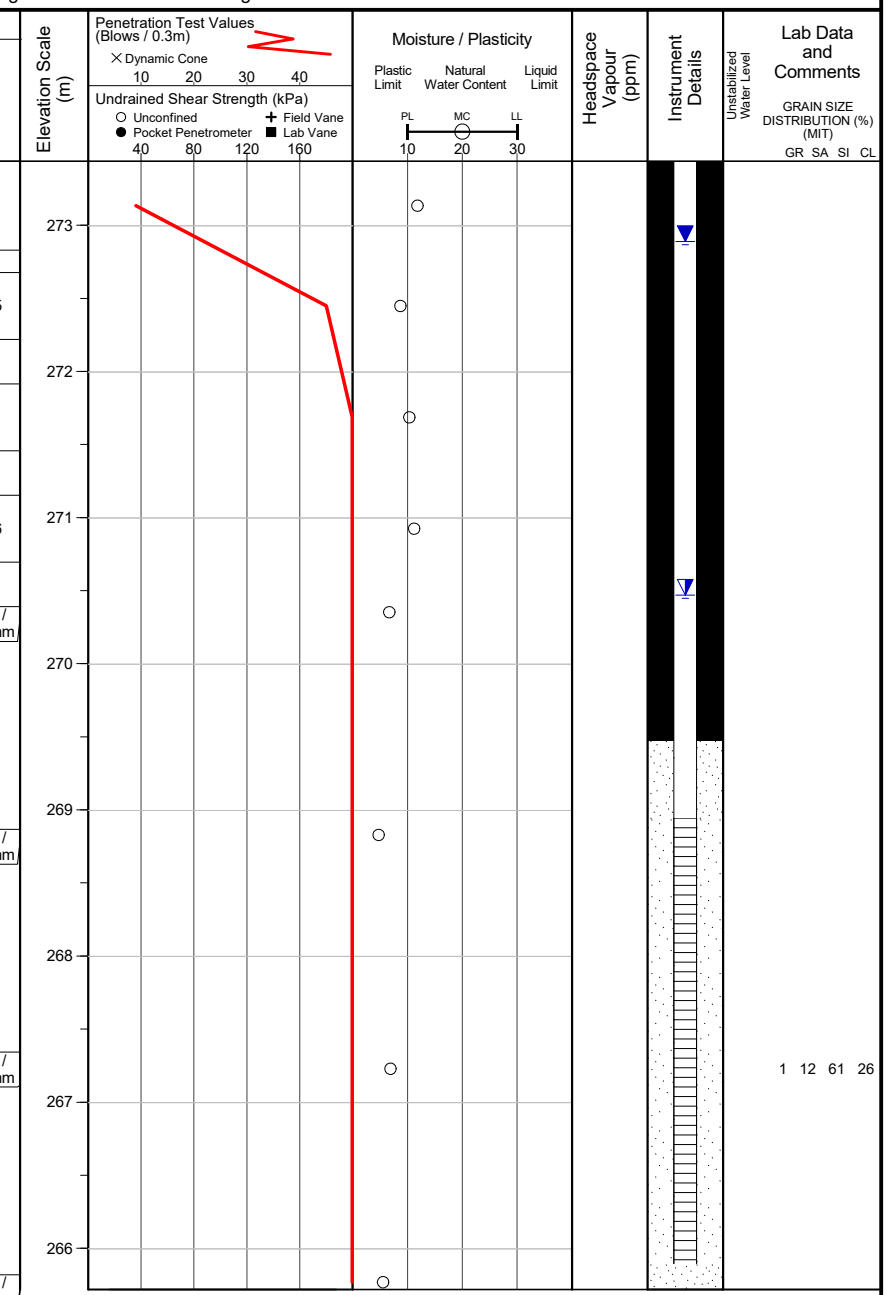
Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 17, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585426, N: 4834824 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	273.4	**GROUND SURFACE**				
	273.2	180mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, trace gravel, loose, brown, moist		1	SS	9
	272.6					
	0.8	**CLAYEY SILT**, some sand, trace shale fragments, dense, red / brown, moist		2	SS	45
1						
		...at 1.5 m, very dense		3	SS	61
2						
		...at 2.3 m, red, damp		4	SS	76
3				5	SS	50 / 75mm
4						
		...at 4.6 m, grey		6	SS	50 / 75mm
5						
6		...at 6.1 m, red		7	SS	50 / 75mm
7						
	265.7			8	SS	50 / 100mm
	7.7	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	3.0	270.5
Dec 21, 2018	0.6	272.9

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 7D

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585418, N: 4834983 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	273.8	**GROUND SURFACE**				
		Continuous Drill, No Samples Collected				

Elevation Scale (m): 273, 272, 271, 270, 269, 268, 267, 266, 265, 264

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

file: 1-18-0438 bh logs.gpj

(continued next page)

LOG OF BOREHOLE 7D

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 2 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585418, N: 4834983 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
		(continued)					
11		Continuous Drill, No Samples Collected *(continued)*					263
12							262
13							261
14							260
15							259
16							258
17							257
18	255.5 / 18.3	**END OF BOREHOLE**					256

Penetration Test Values (Blows / 0.3m): ✕ Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit | Natural Water Content | Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and caved to 17.4 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	2.6	271.2
Dec 21, 2018	1.1	272.7

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 8

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585493, N: 4834863 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	273.8	**GROUND SURFACE**					
0	273.6	150mm **TOPSOIL**					
	0.2	**SANDY CLAYEY SILT**, trace gravel, trace rootlets		1	SS	6	
	273.0						
	0.8	**CLAYEY SILT**, some sand, trace shale fragments, dense, red / brown, damp		2	SS	44	273
1							
		...at 1.5 m, moist		3	SS	39	272
2							
		...at 2.3 m, very dense, red, damp		4	SS	65	
							271
3				5	SS	85 / 275mm	
							270
4							
				6	SS	50 / 125mm	269
5							
							268
6				7	SS	50 / 150mm	
							267
7							
				8	SS	50 / 125mm	266
8							
							265
9				9	SS	50 / 100mm	
							264
10							

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

(continued next page)

LOG OF BOREHOLE 8

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 2 of 2	Location : Glen Williams, ON	Checked by : SO

Position : E: 585493, N: 4834863 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL MC LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
		(continued)										
11		**CLAYEY SILT**, some sand, trace shale fragments, dense, red / brown, damp *(continued)*		10	SS	50 / 75mm	263					
12				11	SS	50 / 125mm	262					...at 12.3m, auger grinding to 13.4m
13							261					
14		...at 13.7 m, wet		12	SS	50 / 50mm	260					...at 13.7m, spoon wet
	258.9 14.9						259					

END OF BOREHOLE

Unstabilized water level measured at 14.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	14.0	259.8
Nov 2, 2018	2.9	271.0
Dec 21, 2018	0.8	273.0

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 9

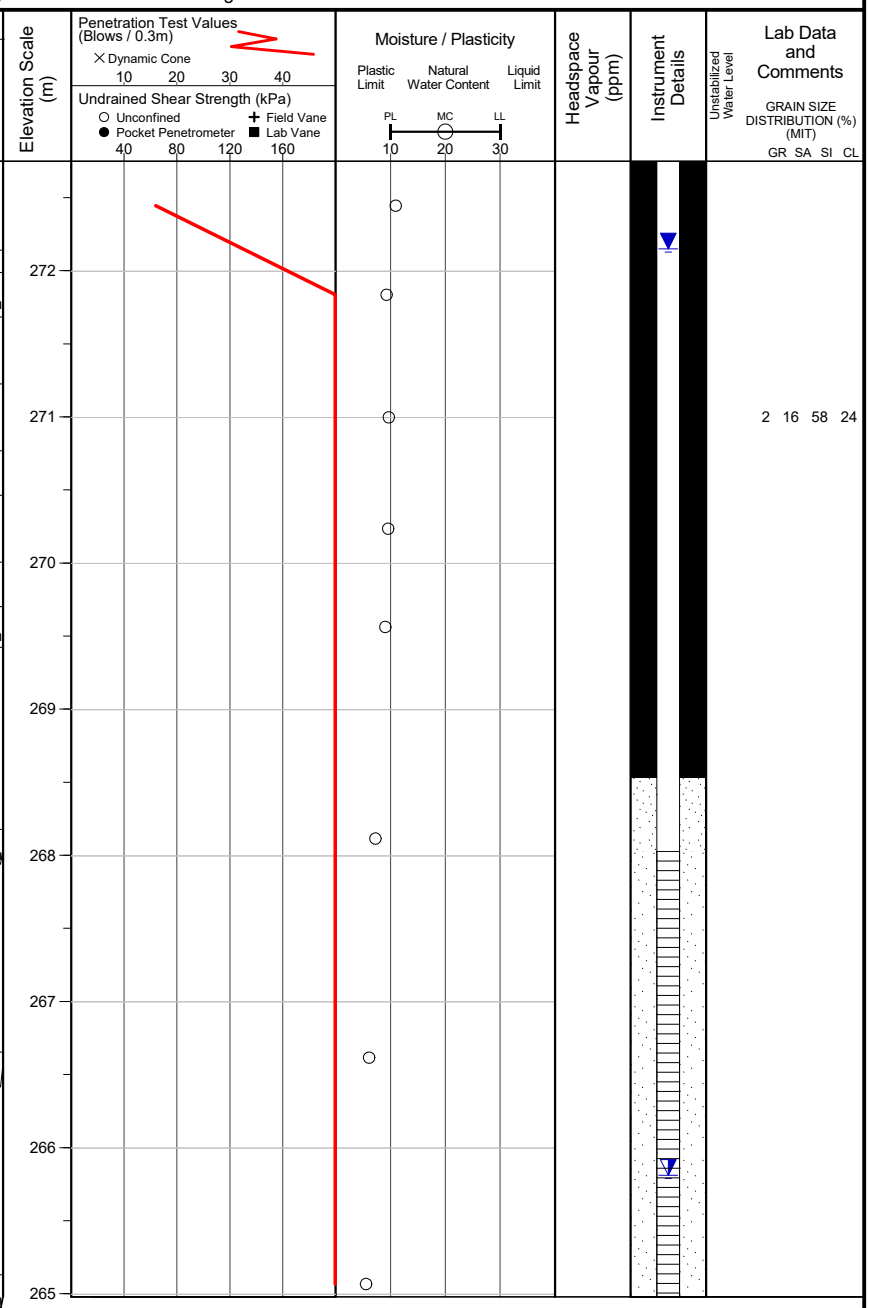
Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585466, N: 4834754 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	272.8	**GROUND SURFACE**				
	272.6	230mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, trace gravel, compact, red / brown, damp		1	SS	16
	272.0					
1	0.8	**CLAYEY SILT**, some sand, trace gravel, very dense, red / brown, damp		2	SS	50 / 150mm
				3	SS	74
2				4	SS	86
3				5	SS	50 / 125mm
4		...at 4.6 m, trace shale fragments		6	SS	50 / 125mm
5						
6		...at 6.1 m, red		7	SS	50 / 75mm
7						
	265.0			8	SS	50 / 125mm
	7.8	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	6.9	265.8
Dec 21, 2018	0.6	272.2

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 10

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 19, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585534, N: 4834802 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	273.4	**GROUND SURFACE**				
	273.2	150mm **TOPSOIL**				
	0.2	**CLAYEY SILT**, some sand, loose, dark brown, damp		1	SS	8
1		...at 0.8 m, dense, red/brown, moist		2	SS	34
		...at 1.5 m, trace gravel		3	SS	33
2	271.1					
	2.3	**SANDY CLAYEY SILT**, trace gravel, dense, red / brown, moist		4	SS	46
3		...at 3.0 m, trace shale fragments, very dense		5	SS	57
4						
		...at 4.6 m, red, damp		6	SS	50 / 50mm
5						
6				7	SS	50 / 50mm
7	265.7			8	SS	50 / 125mm
	7.7	**END OF BOREHOLE**				

Elevation Scale (m): 273, 272, 271, 270, 269, 268, 267, 266

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	4.6	268.9
Dec 21, 2018	0.8	272.6

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 11

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 18, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585574, N: 4834887 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	274.6	**GROUND SURFACE**				
0	274.4	150mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, trace gravel, trace rootlets, loose, dark brown, moist		1	SS	6
		...at 0.8 m, very dense, brown		2	SS	55
1						
				3	SS	44
2						
				4	SS	68
	271.6					
3	3.0	**CLAYEY SILT**, some sand, trace shale fragments, very dense, red / brown, damp		5	SS	87
4						
				6	SS	68
5						
	268.5					
6	6.1	**SANDY CLAYEY SILT**, trace shale fragments, very dense, red / brown, damp		7	SS	50 / 75mm
7						
	266.9			8	SS	50 / 125mm
	7.7	**END OF BOREHOLE**				

Elevation Scale (m): 274, 273, 272, 271, 270, 269, 268, 267

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

	GR	SA	SI	CL
1	1	25	48	26

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 21, 2018	3.4	271.2
Dec 21, 2018	1.3	273.3

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 12

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 18, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585535, N: 4834681 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	270.9	**GROUND SURFACE**				
	270.6	260mm **TOPSOIL**				
	0.3	**SANDY CLAYEY SILT**, trace gravel, compact, red / brown, damp		1	SS	6
	270.1					
1	0.8	**CLAYEY SILT**, some sand, trace gravel, compact, red / brown, moist		2	SS	14
	269.4					
	1.5	**GRAVEL AND SAND**, some silt, trace clay, compact, brown, moist		3A	SS	10
2				3B		
				4	SS	7
3				5	SS	23
4		...at 4.6 m, very dense, wet		6	SS	50 / 75mm
5						
6	264.8					
	6.1	**CLAYEY SILT**, some sand, trace shale fragments, very dense, grey, moist		7	SS	50 / 125mm
7	263.2					
	7.7			8	SS	50 / 75mm

Elevation Scale (m): 270, 269, 268, 267, 266, 265, 264

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

37 46 12 5

...at 6.1m, auger grinding to 7.6m

END OF BOREHOLE

Unstabilized water level measured at 5.8 m below ground surface; borehole caved to 7.3 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

W1 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	dry	n/a
Dec 21, 2018	3.3	267.6

W2 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	5.8	265.1
Nov 2, 2018	4.7	266.2
Dec 21, 2018	3.5	267.4

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 13

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 18, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585607, N: 4834777 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
272.8	**GROUND SURFACE**			
272.6 / 0.2	150mm **TOPSOIL**			
	SANDY CLAYEY SILT, trace gravel, trace rootlets, compact, brown, moist	1	SS	10
		2	SS	23
		3	SS	36
270.5 / 2.3	**GRAVEL AND SAND**, some silt, trace clay, compact, brown, moist	4	SS	21
269.8 / 3.0	**SANDY CLAYEY SILT**, trace gravel, very dense, brown, moist ...at 3.2 m, thin sand seam	5	SS	50
268.2 / 4.6	**CLAYEY SILT**, some sand, trace gravel, very dense, red / brown, damp	6	SS	50 / 150mm
		7	SS	50 / 75mm
265.1 / 7.7		8	SS	50 / 75mm

END OF BOREHOLE

Borehole was dry and caved to 7.3 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	dry	n/a
Nov 2, 2018	5.8	267.0
Dec 21, 2018	3.5	269.3

file: 1-18-0438 bh logs.gpj

LOG OF BOREHOLE 14

Terraprobe

Project No. : 1-18-0438	Client : 2147925 Ontario Inc. c/o Condeland Engineering Limited	Originated by : BR
Date started : October 18, 2018	Project : West Half Lot 21, Concession 9 (Esquesing)	Compiled by : KR
Sheet No. : 1 of 1	Location : Glen Williams, ON	Checked by : SO

Position : E: 585668, N: 4834852 (UTM 17T) Elevation Datum : Geodetic

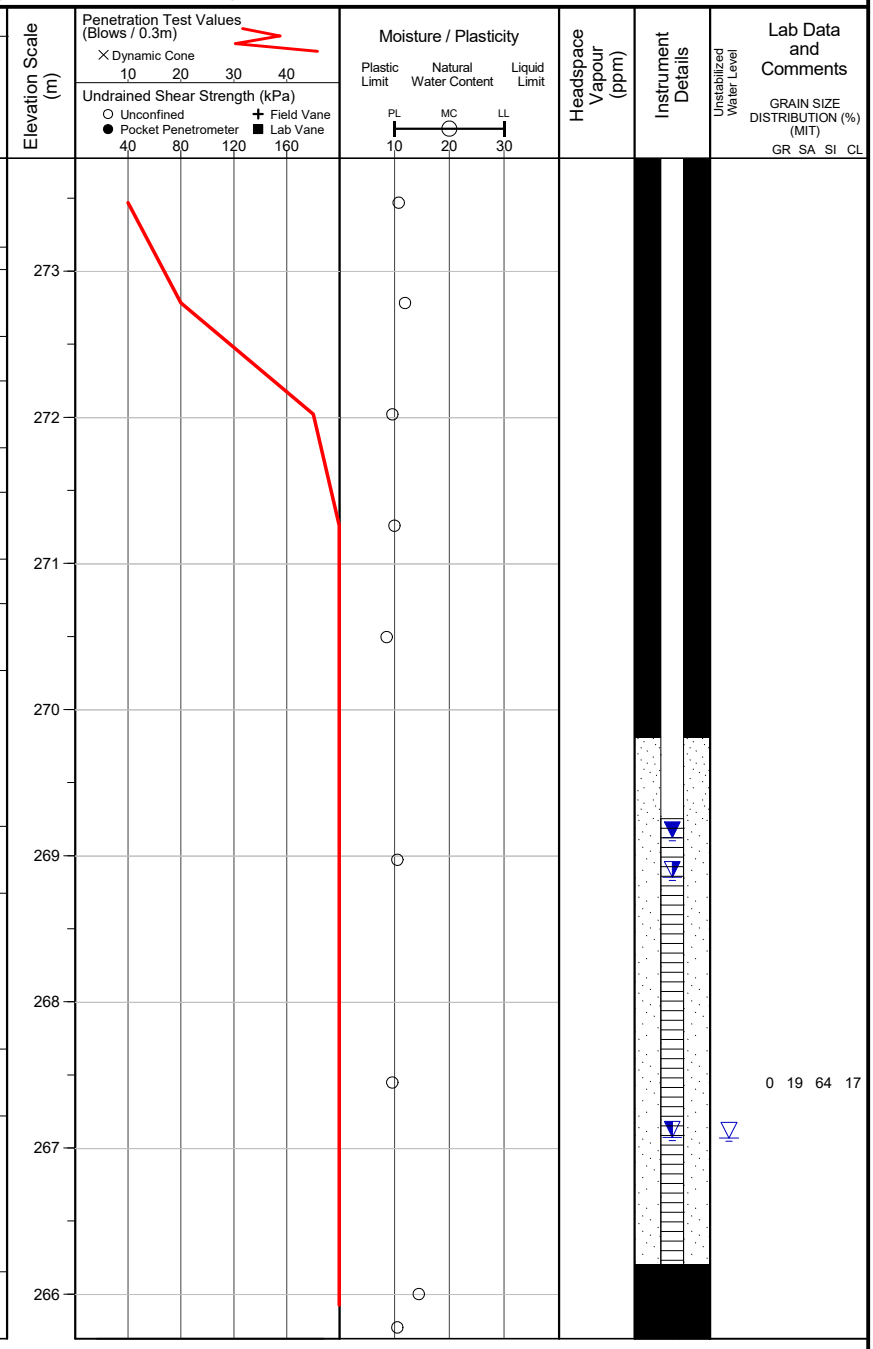
Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	273.8	**GROUND SURFACE**				
	273.6	150mm **TOPSOIL**				
	0.2	**SANDY CLAYEY SILT**, trace gravel, compact, brown, moist		1	SS	10
1				2	SS	20
		...at 1.5 m, dense		3	SS	45
2		...at 2.3 m, very dense		4	SS	53
	270.8					
3	3.0	**SILT**, some sand, some clay, trace gravel, very dense, brown, moist		5	SS	59
4						
		...at 4.6 m, red/brown		6	SS	51
5						
6		...at 6.1 m, damp		7	SS	86
	267.2					
	6.6	**SAND**, compact, brown, wet				
7				8A	SS	56
	265.9					
8	265.7			8B		
	8.1	**CLAYEY SILT**, some sand, trace gravel, hard, red, damp				

END OF BOREHOLE

Unstabilized water level measured at 6.7 m below ground surface; borehole caved to 7.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.



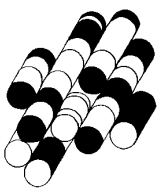
WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2018	6.7	267.1
Nov 2, 2018	4.9	268.9
Dec 21, 2018	4.7	269.1

file: 1-18-0438 bh logs.gpj

APPENDIX D

TERRAPROBE INC.



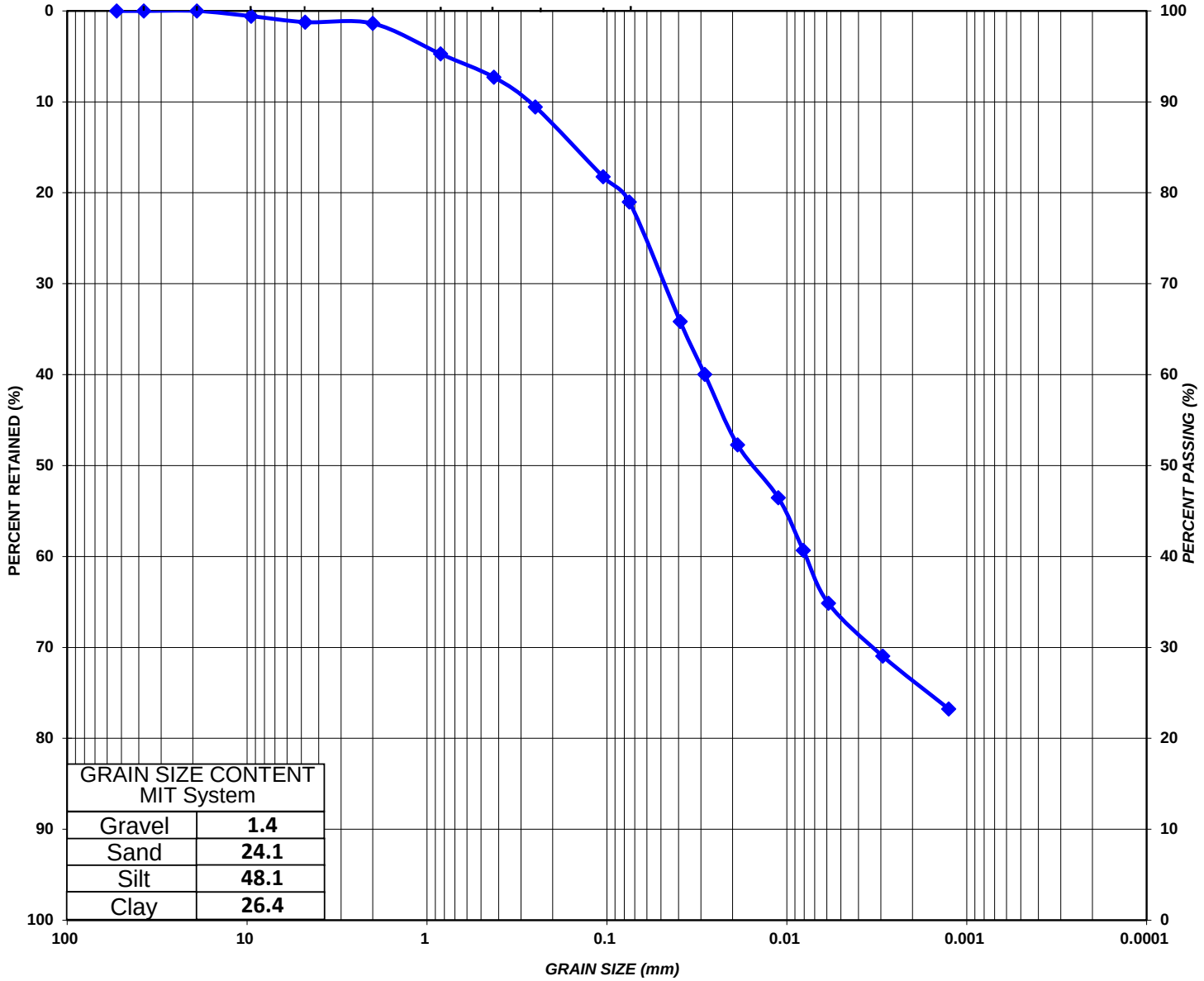
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 11
SAMPLE NUMBER: 1
SAMPLE DEPTH: 0' - 2'
SAMPLE DESCRIPTION: SANDY CLAYEY SILT, trace gravel

FILE NO.: 1-18-0438
LAB NO.: 1288A
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS



GRAIN SIZE CONTENT MIT System	
Gravel	1.4
Sand	24.1
Silt	48.1
Clay	26.4

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

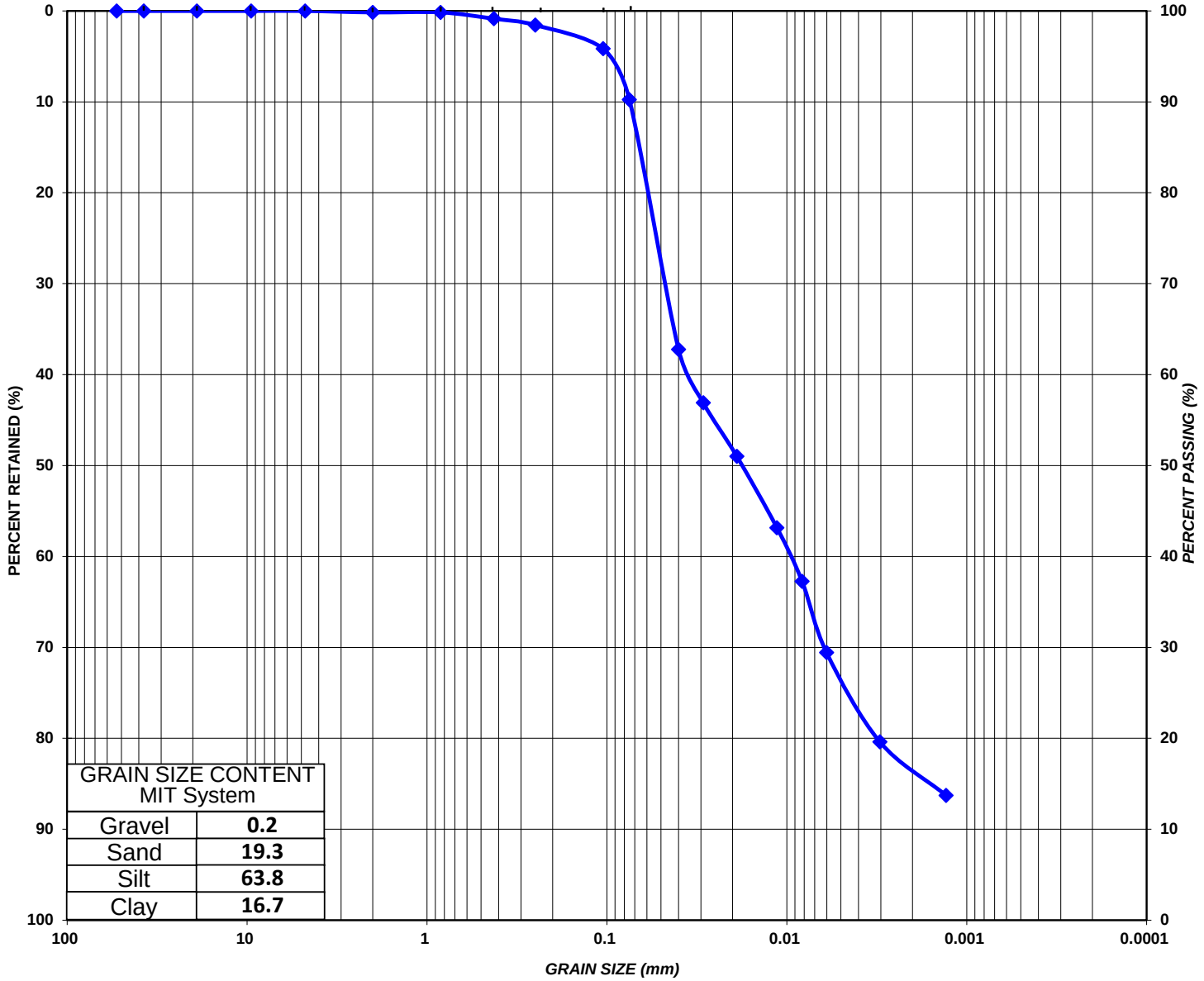
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 14
SAMPLE NUMBER: 7
SAMPLE DEPTH: 20' - 21'6"
SAMPLE DESCRIPTION: SILT, some sand, some clay, trace gravel

FILE NO.: 1-18-0438
LAB NO.: 1288B
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS



GRAIN SIZE CONTENT MIT System	
Gravel	0.2
Sand	19.3
Silt	63.8
Clay	16.7

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

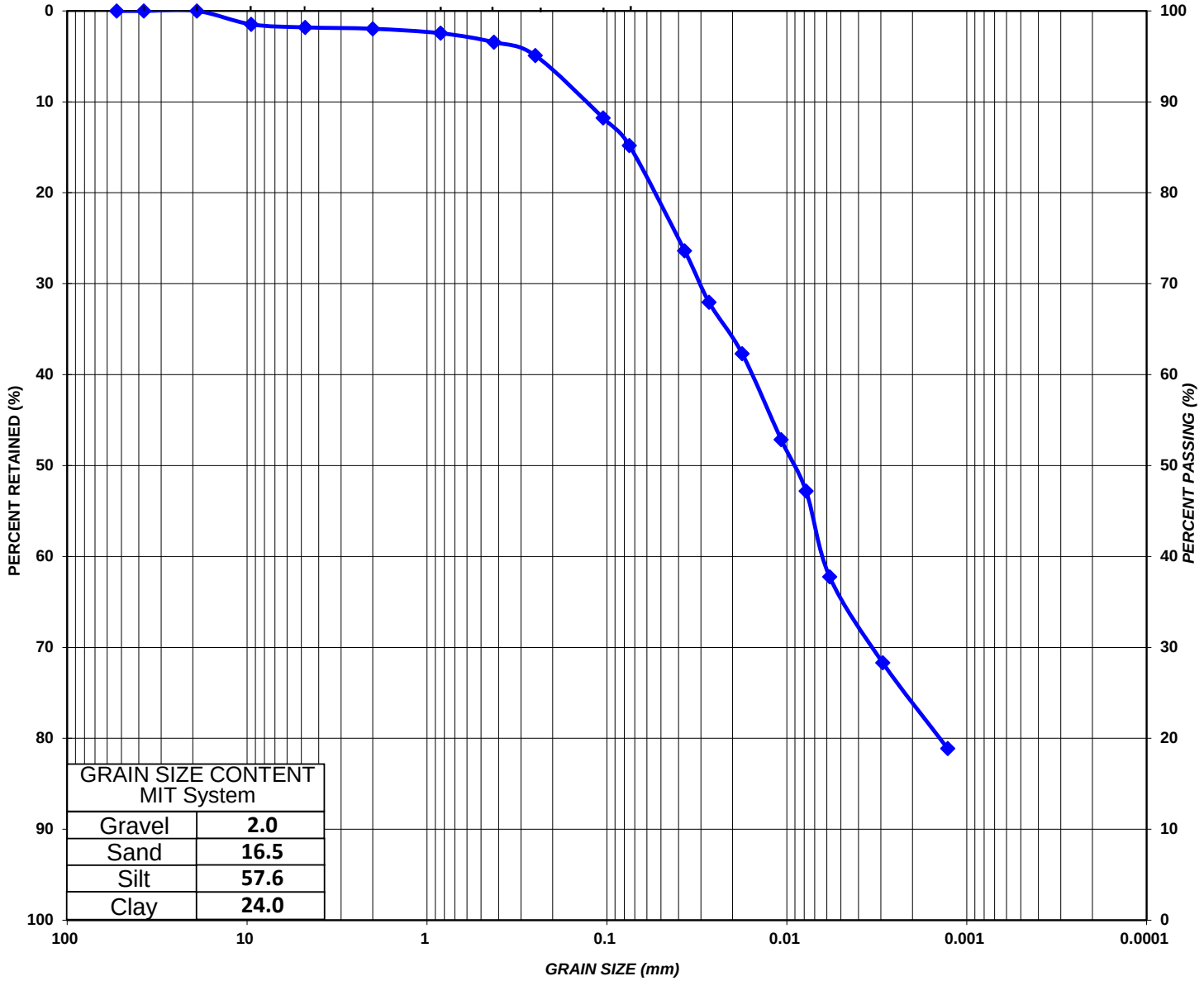
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 9
SAMPLE NUMBER: 3
SAMPLE DEPTH: 5' - 6'6"
SAMPLE DESCRIPTION: CLAYEY SILT, some sand, trace gravel

FILE NO.: 1-18-0438
LAB NO.: 1288C
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS



GRAIN SIZE CONTENT MIT System	
Gravel	2.0
Sand	16.5
Silt	57.6
Clay	24.0

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

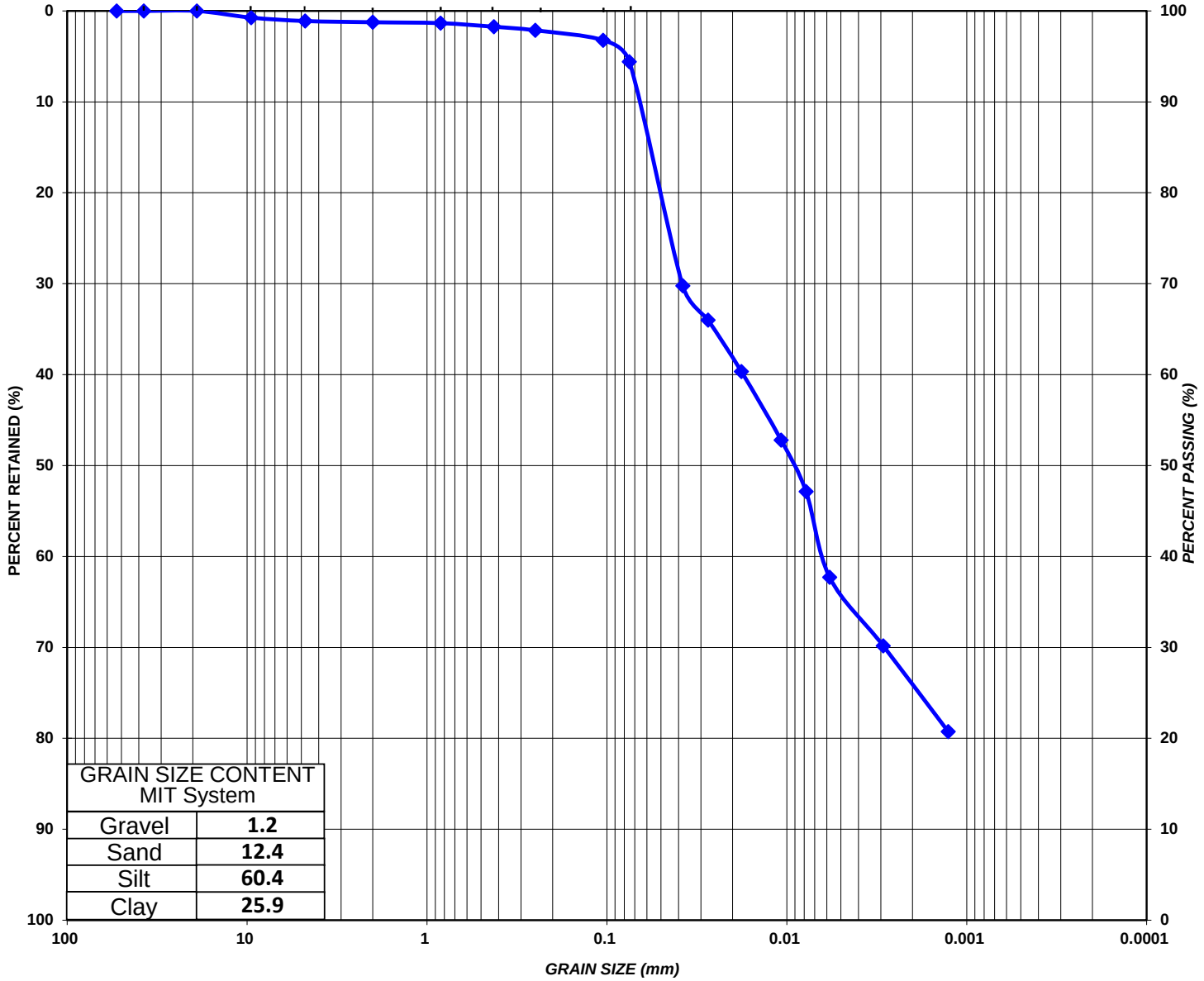
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 7
SAMPLE NUMBER: 7
SAMPLE DEPTH: 20' - 21'6"
SAMPLE DESCRIPTION: CLAYEY SILT, some sand, trace gravel

FILE NO.: 1-18-0438
LAB NO.: 1288D
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS



GRAIN SIZE CONTENT MIT System	
Gravel	1.2
Sand	12.4
Silt	60.4
Clay	25.9

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

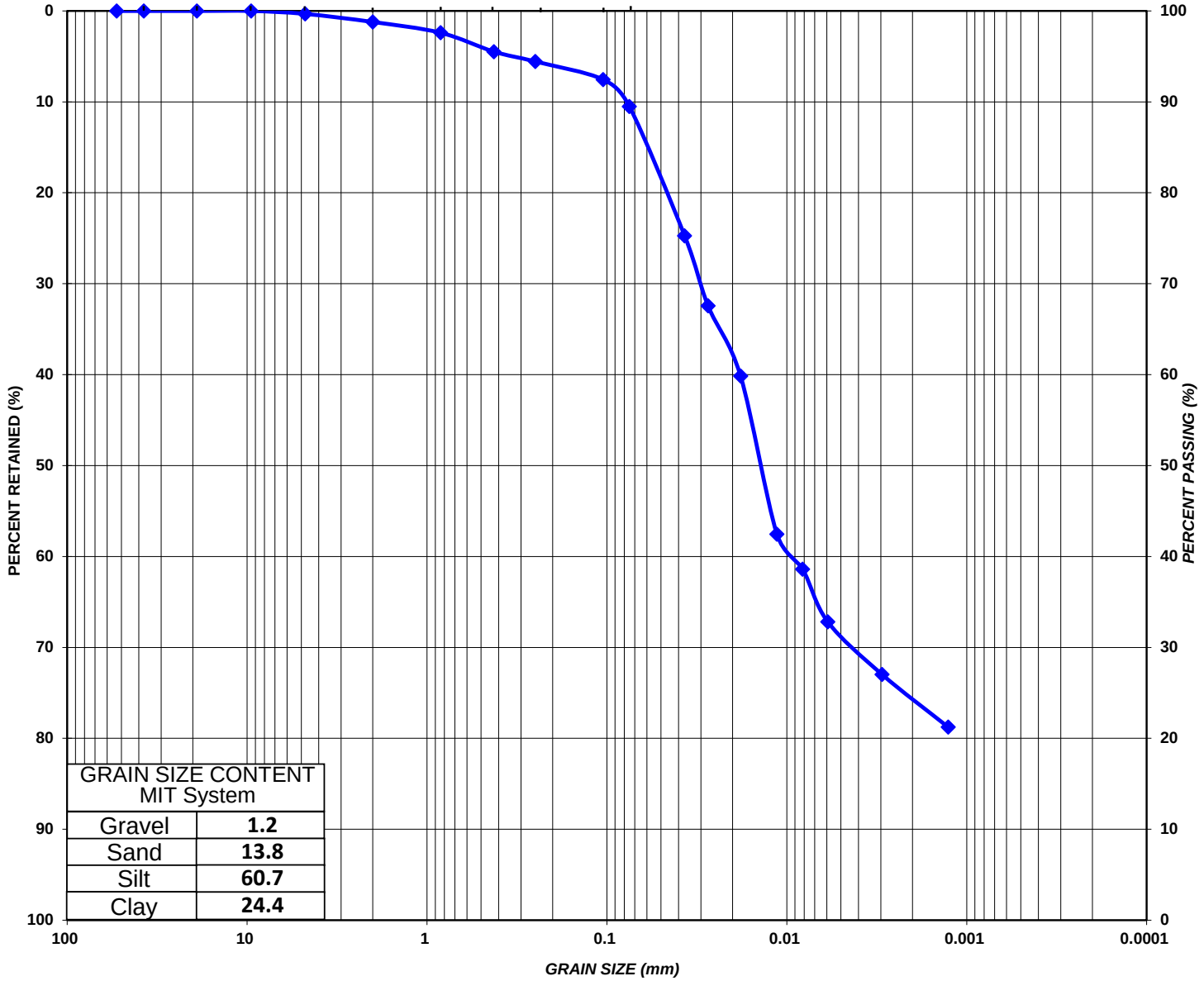
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 4
SAMPLE NUMBER: 12
SAMPLE DEPTH: 45' - 46'6"
SAMPLE DESCRIPTION: CLAYEY SILT, some sand, trace gravel

FILE NO.: 1-18-0438
LAB NO.: 1288E
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS



GRAIN SIZE CONTENT MIT System	
Gravel	1.2
Sand	13.8
Silt	60.7
Clay	24.4

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

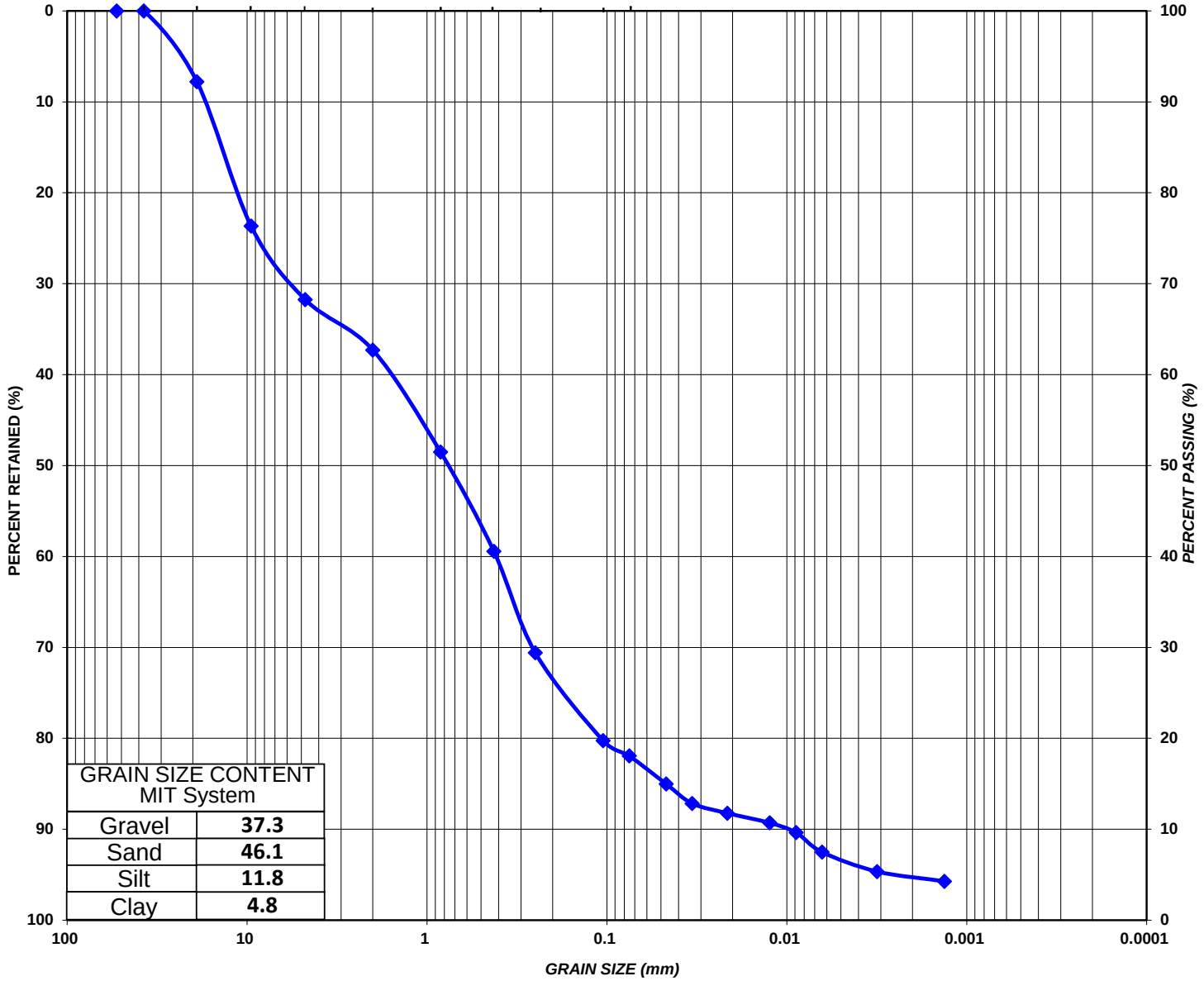
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: West Half Lot 21, Concession 9 (Esquesing), Glen Williams, C
LOCATION: Glen Williams, On.
CLIENT: 2147925 Ontario Inc. C/O Condeland Engineering Limited
BOREHOLE: 12
SAMPLE NUMBER: 6
SAMPLE DEPTH: 20' - 21'6"
SAMPLE DESCRIPTION: GRAVEL AND SAND, some silt, trace clay

FILE NO.: 1-18-0438
LAB NO.: 1288F
SAMPLE DATE: Oct 16, 2018
SAMPLED BY: B.R.

GRAIN SIZE DISTRIBUTION ANALYSIS

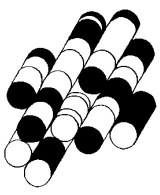


GRAIN SIZE CONTENT MIT System	
Gravel	37.3
Sand	46.1
Silt	11.8
Clay	4.8

MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				

APPENDIX E

TERRAPROBE INC.



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

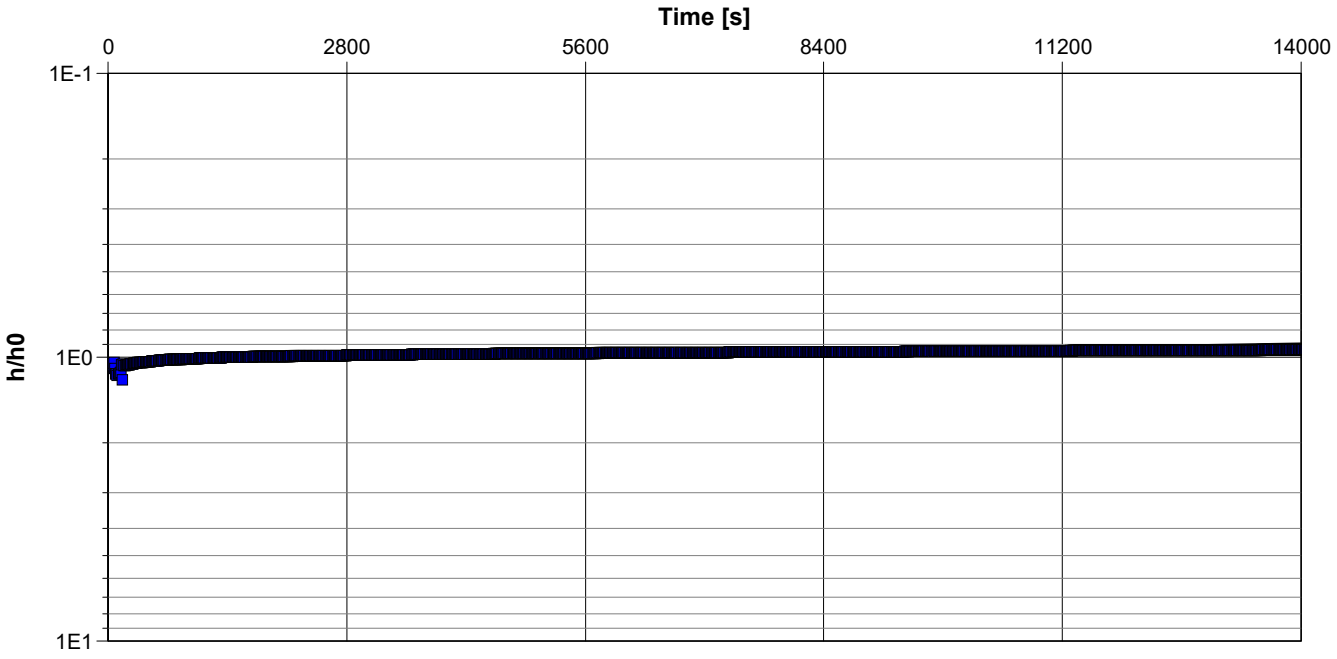
Slug Test - Analyses Report

Project: West Half Lot 21, Concession 9

Number: 1-18-0438

Client: 2147925 Ontario Inc.

Location: Glen Williams, ON	Slug Test: Rising Head Test BH1	Test Well: BH1
Test Conducted by: BR		Test Date: 11/2/2018
Analysis Performed by: SAA	Single Well Response Test	Analysis Date: 12/21/2018
Aquifer Thickness: 5.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH1	2.61×10^{-8}	

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Construction Materials Engineering, Inspection & Testing

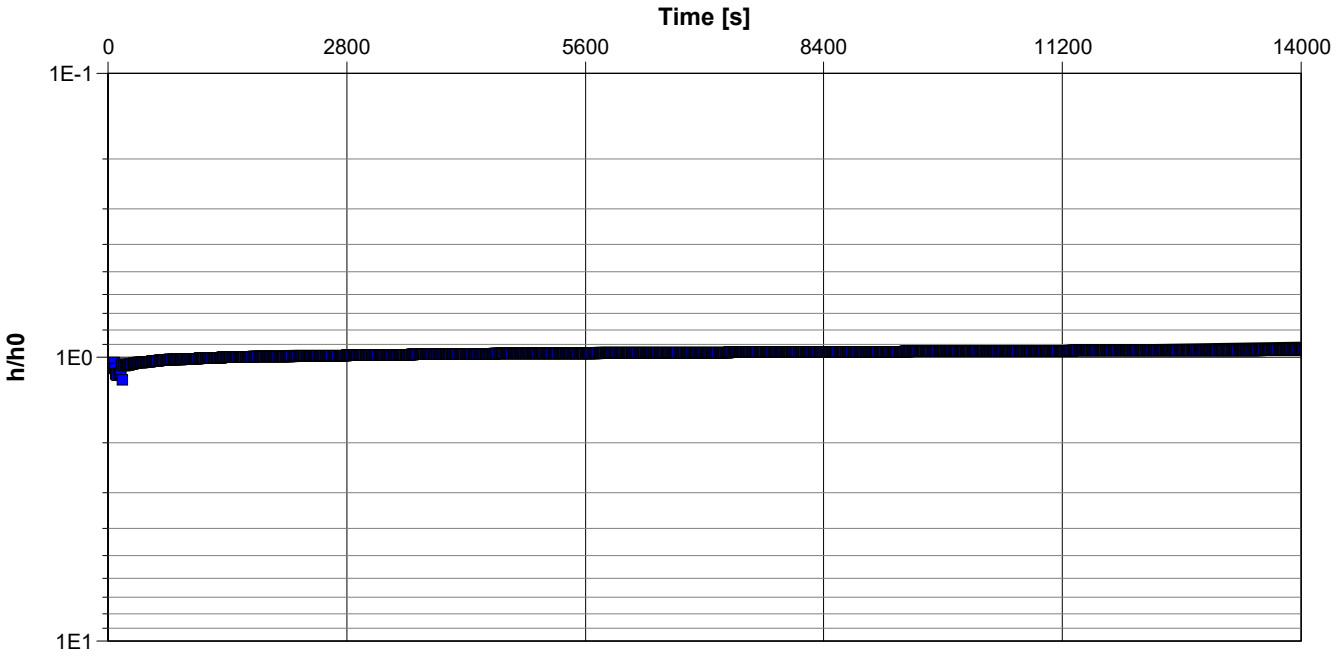
Slug Test - Analyses Report

Project: West Half Lot 21, Concession 9

Number: 1-18-0438

Client: 2147925 Ontario Inc.

Location: Glen Williams, ON	Slug Test: Rising Head Test BH3S	Test Well: BH3S
Test Conducted by: BR		Test Date: 11/2/2018
Analysis Performed by: SAA	Single Well Response Test	Analysis Date: 12/21/2018
Aquifer Thickness: 2.30 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH3S	3.68×10^{-8}	

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Construction Materials Engineering, Inspection & Testing

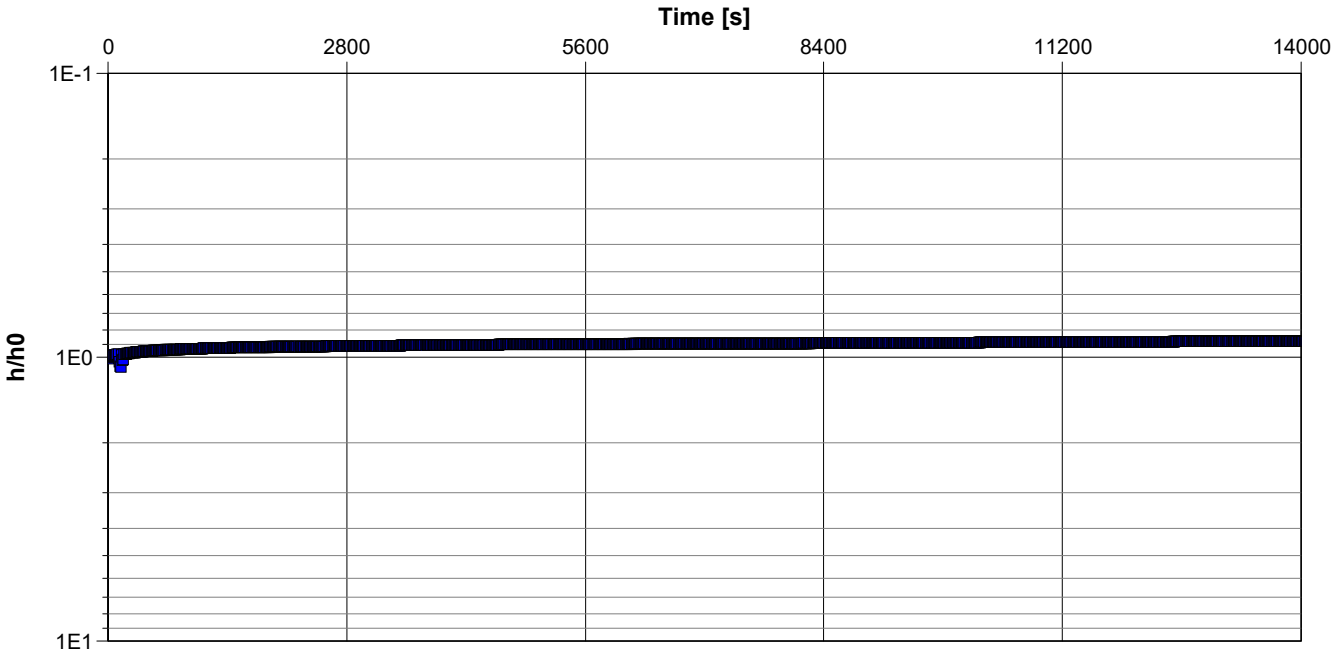
Slug Test Analysis Report

Project: West Half Lot 21, Concession 9

Number: 1-18-0438

Client: 2147925 Ontario Inc.

Location: Glen Williams, ON	Slug Test: Rising Head Test BH5	Test Well: BH5
Test Conducted by: BR		Test Date: 11/2/2018
Analysis Performed by: SAA	Single Well Response Test	Analysis Date: 12/21/2018
Aquifer Thickness: 7.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH5	2.08×10^{-8}	

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

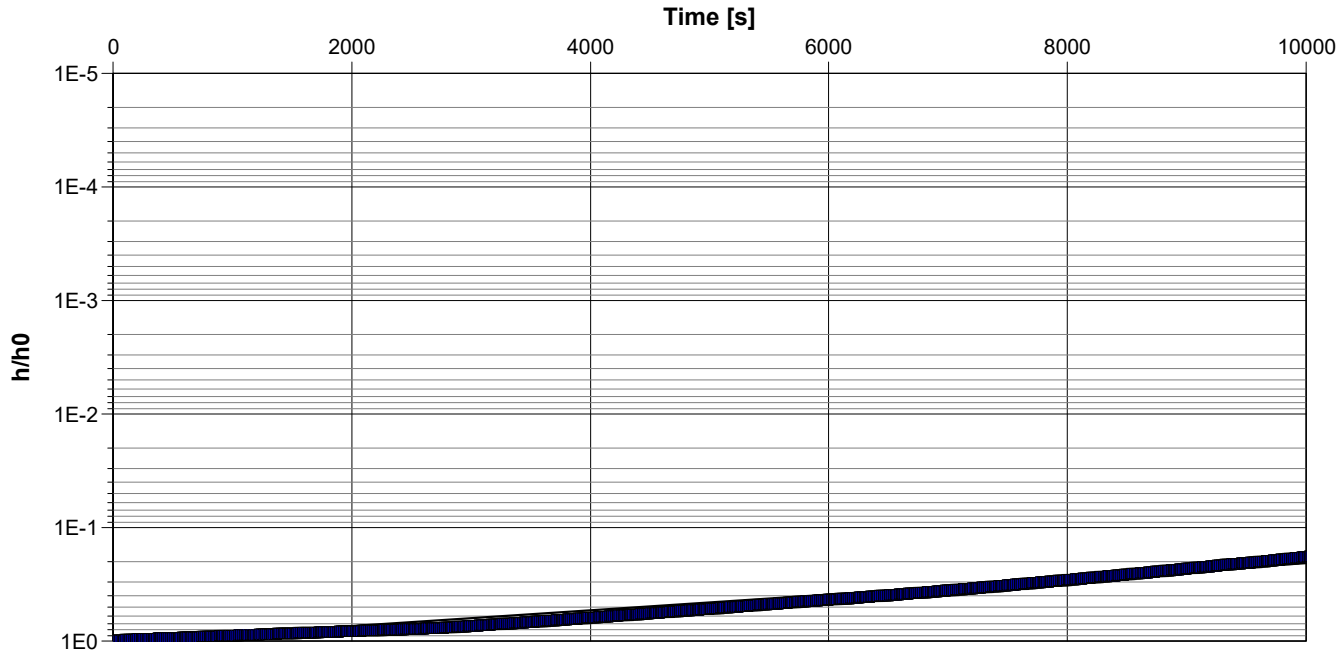
Slug Test - Analyses Report

Project: West Half Lot 21, Concession 9

Number: 1-18-0438

Client: 2147925 Ontario Inc.

Location: Glen Williams, ON	Slug Test: Rising Head Test BH8	Test Well: BH8
Test Conducted by: BR		Test Date: 11/2/2018
Analysis Performed by: SAA	Single Well Response Test	Analysis Date: 12/21/2018
Aquifer Thickness: 15.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH8	4.31×10^{-7}	

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

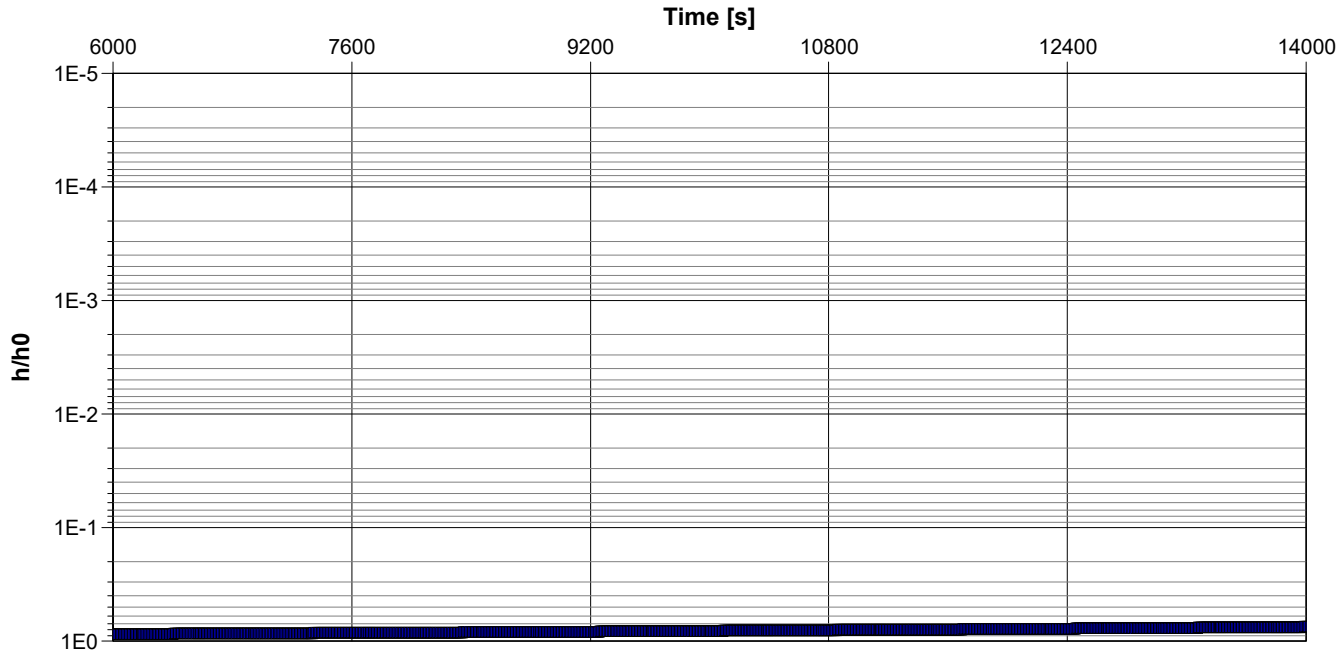
Slug Test - Analyses Report

Project: West Half Lot 21, Concession 9

Number: 1-18-0438

Client: 2147925 Ontario Inc.

Location: Glen Williams, ON	Slug Test: Rising Head Test BH12D	Test Well: BH12D
Test Conducted by: BR		Test Date: 11/2/2018
Analysis Performed by: SAA	Single Well Response Test	Analysis Date: 12/21/2018
Aquifer Thickness: 2.00 m		

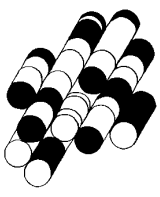


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH12D	6.78×10^{-8}	

APPENDIX F

TERRAPROBE INC.

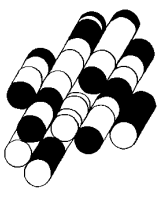


Appendix F - Environment Canada Climate Data
1-18-0438-46

Year	Avg Max Temp (°C)	Avg Min Temp (°C)	Avg Monthly Temp (°C)	Total Rainfall (mm)	Total Snowfall (mm)	Total Precipitation (mm)
1979	11	0	6	700	104	804
1980	12	1	6	705	61	766
1981	12	1	7	840	78	917
1982	12	1	6	896	153	1049
1983	13	2	7	799	85	884
1984	12	1	7	724	133	857
1985	12	0	6	868	214	1081
1986	12	1	7	974	104	1078
1987	13	1	7	681	110	790
1988	13	1	7	670	110	780
1989	12	1	6	601	124	725
1990	14	2	8	824	121	945
1991	14	2	8	746	163	909
1992	12	1	6	932	133	1066
1993	12	1	6	641	147	789
1994	13	0	6	620	203	823
1995	13	1	7	818	134	953
1996	12	1	6	879	182	1061
1997	12	1	6	564	212	776
1998	15	3	9	671	82	753
1999	13	1	7	699	149	849
2000	12	0	6	757	241	997
2001	14	2	8	658	112	770
2002	14	3	8	492	121	613
2003	13	1	7	631	117	748
2004	13	2	7	572	120	691
2005	14	2	8	644	137	781
2006	15	4	9	839	24	863
2007	14	2	8	311	56	367
2008	13	1	7	454	77	531
2009	13	1	7	516	36	552
2010	15	3	9	435	24	458
2011	14	2	8	559	72	631
2012	16	4	10	376	27	403
2013	13	2	8	367	56	423
2014	13	0	7	397	69	466
2015	14	1	8	263	14	277
2016	15	2	9	306	62	368
2017	14	3	8	564	49	613
Average (per annum)	13	1	7.3	641	108	749

APPENDIX G

TERRAPROBE INC.



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

November 2, 2018

File No. 1-18-0438
Brampton Office

Dear Resident/ Property Owner:

RE: PRIVATE WELL INVENTORY
PROPOSED RESIDENTIAL SUBDIVISION
PART OF WEST HALF OF LOT 21, CONCESSION 9
(ESQUESING), HAMLET OF GLEN WILLIAMS, ONTARIO

Terraprobe Inc. was retained by 2147925 Ontario Inc., to undertake a private well inventory for properties within the vicinity of the West Half of Lot 21, Concession 9, as part of the study for the proposed residential subdivision. The project is located in the Hamlet of Glen Williams. The well inventory is being conducted to identify private wells within the vicinity of the proposed building.

The purpose of our visit is to conduct interviews with local residents and land owners in regards to water supply wells in operation surrounding the development project. The information we hope to obtain will include:

1. The Location of the well(s) and septic bed (if known)
2. The depth, diameter and construction details of the well(s);
3. The pump type and depth, and any water treatment systems in use;
4. Information regarding the past performance of the well(s);

A copy of the completed questionnaire will be provided upon request. We anticipate that these questions can be answered in a few minutes. If there is access to your well, and with your permission, our representatives will measure the depth and level of water in your well. In addition, we will collect a water quality sample from your tap (with your permission). The results of the water quality testing will be provided to you by mail.

Although you were not at home today when we visited, our staff will be working in the area for the next several weeks. If you would like to participate in the survey, and there is a particular time that suits your schedules, please contact Kyle Reed or Samuel Oyedokun Terraprobe at (905) 796-2650, any question you may have regarding the survey can also be answered at that time. When calling please reverse the long distance charges and indicate to the receptionist that you are calling in regards to the "Proposed Residential Subdivision, Well Survey". Our receptionist is available during regular working hours of 8:30 am to 5 pm. The questionnaire may also be completed over the telephone, or the attached questions can be answered and forwarded via email to kreed@terraprobe.ca or soyedokun@terraprobe.ca

We understand that your participation in this survey is voluntary; however your co-operation is greatly appreciated. Thank you for your consideration of our private well inventory.

Yours truly,
Terraprobe Inc.

Kyle Reed, P. Geo.
Project Manager

Samuel Oyedokun, P.Eng ., PMP., QP_{ESA}
Associate

Brampton Office

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

November 2, 2018

File No. 1-18-0438-46
Brampton Office

Dear Resident/Property Owner:

RE: PRIVATE WELL INVENTORY
PROPOSED RESIDENTIAL SUBDIVISION
PART OF WEST HALF OF LOT 21, CONCESSION 9
(ESQUESING), HAMLET OF GLEN WILLIAMS, ONTARIO

If you have received the attached letter regarding the above mentioned water well inventory, it's because you were unavailable at the time of door-to-door canvassing and if you would like to participate in the well survey we ask that you please contact Kyle Reed or Samuel Oyedokun of Terraprobe at (905) 796-2650 or by email at kreed@terraprobe.ca or soyedokun@terraprobe.ca

If replying to the well survey by telephone or email, the following information pertaining to the well is requested, if known:

- Type of well (i.e. drilled, dug, bored)
- Casing material (i.e. Metal, concrete, stone, etc.)
- Pump type & depth (i.e. Submersible [Pump in well]/Jet Pump [Pump in house])
- Water treatment systems in use (i.e. Water Softener, Reverse Osmosis, UV light)
- Date well was constructed
- Depth of well
- Use of the well (i.e. Residential/Agriculture/Livestock/Commercial etc.)
- Number of residents/people well supplies water
- Past water quality problems with well (i.e. High bacteria levels, high iron, etc,)
- Past water quantity problems with well (i.e. Does/has well run dry in past, why?)
- Is well water consumed, or is water purchased for consumption (i.e. bottled water)
- Any past operating problems with well detailing the nature of the problem and when it occurred.

Your response and participation in our water well monitoring program is appreciated. Thank you for your consideration in this matter.

Terraprobe Inc.

Greater Toronto:
11 Indell Lane
Brampton, ON L6T 3Y3
Tel: (905) 796-2650
Fax: (905) 796-2250
brampton@terraprobe.ca

Hamilton-Niagara:
903 Barton Street, #22
Stoney Creek, ON L8E 5P5
Tel: (905) 643-7560
Fax: (905) 643-7559
stoneycreek@terraprobe.ca

Central Ontario:
220 Bayview Drive, #25
Barrie, ON L4N 4Y8
Tel: (705) 739-8355
Fax: (705) 739-8369
barrie@terraprobe.ca

Northern Ontario:
1012 Kelly Lake Rd., #1
Sudbury, ON P3E 5P4
Tel: (705) 670-0460
Fax: (705) 670-0558
sudbury@terraprobe.ca

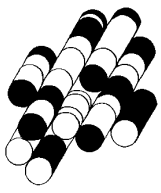
www.terraprobe.ca

HYDROGEOLOGICAL STUDY
DOOR TO DOOR SURVEY RESULTS
PROPOSED RESIDENTIAL SUBDIVISION
WEST HALF LOT 21, CONCESSION 9 (ESQUESING)
HAMLET OF GLEN WILLIAMS, ONTARIO

#	ADDRESS	NAME	WELL TYPE	WELL DEPTH (m)	WATER LEVEL (m)	WELL ASSESSIBLE	Water Sample Collected	COMMENTS
	Private Well Survey (November 5 - 19, 2018)							
	8th Line							
1	12184 8th Line	Dave William	Drilled	36	3	No	No	Resident reported good water quality and quantity. Constructed in 1969. Softener for water treatment.
2	12282 8th Line	Barry Buckwell	N/A	N/A	N/A	N/A	N/A	Resident reported on municipal water supply.
	Wildwood Road							
3	90 Wildwood Road	Nancy Pundsack	N/A	N/A	N/A	N/A	N/A	Resident reported on municipal water supply.

APPENDIX H

TERRAPROBE INC.



APPENDIX H - Water Balance - Glen Williams

File No. 1-18-0438-46.1

1. Climate Information

Precipitation	749	mm/a	0.75	m/a
Evapotranspiration	505	mm/a	0.51	m/a
Water Surplus	244	mm/a	0.24	m/a

2. Infiltration Rates

Table 2 Approach - Infiltration Factors

Flat land	0.3
Medium combinations of clay and loam	0.2
TOTAL:	0.5

Infiltration (0.5 x 244)	122	mm/a	0.122	m/a
Run-off (244 - 122)	122	mm/a	0.122	m/a

Table 3 Approach - Typical Recharge Rates

silty sand to sandy silt	150 - 200	mm/a
silt	125 - 150	mm/a
clayey silt	100 - 125	mm/a

The site development area is underlain by clayey silt to silty sand till.

Based on the above, the recharge rate is	125	mm/a	0.125	m/a
with runoff of	119	mm/a	0.119	m/a

3. Property Statistics

Pre- Development Site Coverage (before building additions)

Area Covered by Existing Building	0	m^2	0.00	ha
Area Covered by Existing Hard Surface Paving	0	m^2	0.00	ha
Area Covered by Existing Landscaped area	68,840	m^2	6.88	ha
TOTAL	68,840	m^2	6.88	ha

4. Post-Development Coverage

Area Covered by Buildings	17,950	m^2	1.80	ha
Area Covered by Hard Surface Paving	9,590	m^2	0.96	ha
Area Covered by Landscaped Area	41,300	m^2	4.13	ha
TOTAL:	68,840	m^2	6.88	ha

APPENDIX H - Water Balance - Glen Williams

File No. 1-18-0438-46.1

5. Annual Water Balance Before Development

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building Coverage (entire site)	0	0	nil	nil	nil	0
Hard Surface Paving	0	0	nil	nil	nil	0
Landscape Area (entire site)	68,840	51,561	34,764	nil	8,605	8,192
TOTAL	**68,840**	**51,561**	**34,764**	**0**	**8,605**	**8,192**

6. Annual Water Balance After Development

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building Coverage (entire site)	17,950	13,445	nil	nil	nil	13,445
Hard Surface Paving	9,590	7,183	nil	nil	nil	7,183
Landscape Area (entire site)	41,300	30,934	20,857	nil	5,163	4,915
TOTAL	**68,840**	**51,561**	**20,857**	**0**	**5,163**	**25,542**

7. Comparison of Pre-Development and Post-Development

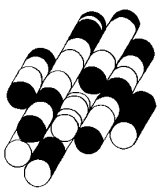
	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	51,561	34,764	nil	8,605	8,192
Post-Development	51,561	20,857	nil	5,163	25,542

8. Requirement for Infiltration of Roof Runoff

Volume of roof (post development) run-off captured (90%)	12,100 m^3
Volume of post-development infiltration without roof run-off	5,163 m^3
Volume of roof run-off required to match pre-development infiltration rates	3,443 m^3
Percentage of roof run-off required to match pre-development infiltration	28%

APPENDIX I

TERRAPROBE INC.



AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC.
11 INDELL LANE
BRAMPTON, ON L6T3Y3
(905) 796-2650

ATTENTION TO: Kyle Reed

PROJECT: 1-18-0438-46

AGAT WORK ORDER: 18T406138

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Nov 12, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T406138

PROJECT: 1-18-0438-46

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Kyle Reed

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - ORPs (Water)

DATE RECEIVED: 2018-11-06

DATE REPORTED: 2018-11-12

		SAMPLE DESCRIPTION:		BH 1	BH 3S	BH 5	BH 8	BH 10	BH 11		BH 12D
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water		Water
		DATE SAMPLED:		2018-11-05	2018-11-05	2018-11-05	2018-11-05	2018-11-05	2018-11-05		2018-11-05
Parameter	Unit	G / S	RDL	9680654	9680659	9680660	9680661	9680662	9680663	RDL	9680664
Nitrate as N	µg/L		50	79	3620	476	286	75	1570	100	1180
Nitrite as N	µg/L		50	<50	<50	105	<50	<50	<50	100	157

		SAMPLE DESCRIPTION:		BH 14	DUP#1
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2018-11-05	2018-11-05
Parameter	Unit	G / S	RDL	9680665	9680666
Nitrate as N	µg/L		50	15400	316
Nitrite as N	µg/L		50	<50	<50

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9680664 Elevated RDLs indicate the degree of sample dilutions prior to the analysis to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instrument.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Iris Verástegui

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 18T406138

PROJECT: 1-18-0438-46

ATTENTION TO: Kyle Reed

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Nov 12, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - ORPs (Water)															
Nitrate as N	9680279		942	908	NA	< 50	97%	70%	130%	105%	70%	130%	106%	70%	130%
Nitrite as N	9680279		<250	<250	NA	< 50	NA	70%	130%	103%	70%	130%	109%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Iris Verástegui

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Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 18T406138

PROJECT: 1-18-0438-46

ATTENTION TO: Kyle Reed

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH

Results relate only to the items tested and to all the items tested

1 Med

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 18T406138

Cooler Quantity:

Arrival Temperatures: 1.5 | 2.5 | 3.7

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: ICE

Report Information:

Company: Terraprobe Inc.
Contact: Kyle Reed
Address: Brampton ON
Phone: Fax:
Reports to be sent to:
1. Email: kreed@terraprobe.ca
2. Email:

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☑ Regulation 153/04
Table 2 (Indicate One)
☐ Ind/Com
☑ Res/Park
☐ Agriculture
Soil Texture (Check One)
☑ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region (Indicate One)
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 1-18-0438-46
Site Location: Glen Williams
Sampled By: B. Racher
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No

Report Guideline on *Certificate of Analysis* ☑ Yes ☐ No

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides))	O. Reg 153: ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	O. Reg 153: Full Metals Scan	O. Reg 153: Regulation/Custom Metals	O. Reg 153: Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☑ NO_3+NO_2	O. Reg 153: Volatiles: ☐ VOC ☐ BTEX ☐ THM	O. Reg 153: PHCs F1 - F4	O. Reg 153: ABNs	O. Reg 153: PAHs	O. Reg 153: PCBs: ☐ Total ☐ Aroclors	O. Reg 153: Organochlorine Pesticides	O. Reg 153: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 153: Sewer Use
BH 1	Nov 5/18		1	GW							✓								
BH 3S			1								✓								
BH 5			1								✓								
BH 8			1								✓								
BH 10			1								✓								
BH 11			1								✓								
BH 12D			1								✓								
BH 14			1								✓								
DUP #1			1								✓								

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Bob Racher	Nov 5/18	4:37pm	Jay Patel	06/11/18	12:34pm

Page 1 of 1

No: T 081452

APPENDIX J

TERRAPROBE INC.

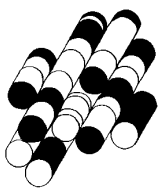


TABLE 1

GROUND WATER ELEVATIONS

West Half Lot 21, Concession 9 (Esquesing)

Glen Williams, ONTARIO

PROJECT #1-18-0438-46

Well ID	MW 1		MW 2		MW 3S		MW 3D		MW 4	
Stick Up (m)	0.81		0.92		1.03		0.99		1.05	
Depth (mbgs)	7.73		7.82		4.16		7.80		15.27	
Top of Screen	268.37		268.68		271.24		269.10		261.03	
Bottom of Screen	265.37		265.68		269.74		266.10		258.03	
Ground Elev. (masl)	273.10		273.50		273.90		273.90		273.30	
Date	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)
19-Oct-18	DRY		DRY		DRY		DRY		14.3	259.00
02-Nov-18	4.18	268.92	5.06	268.44	2.55	271.35	2.39	271.51	2.72	270.58
21-Dec-18	0.725	272.38	0.18	273.32	0.22	273.68	0.59	273.31	0.92	272.38
15-May-19	0.350	272.75	0.10	273.40	0.12	273.78	0.22	273.68	0.54	272.76
11-Nov-20	-	-	2.18	271.32	2.33	271.57	2.42	271.48	-	-

TABLE 1

GROUND WATER ELEVATIONS

West Half Lot 21, Concession 9 (Esquesing)

Glen Williams, ONTARIO

PROJECT #1-18-0438-46

Well ID	MW 5		MW 6		MW 7		MW 7D		MW 8		MW 9	
Stick Up (m)	0.94		1.10		1.02		1.03		1.07		0.91	
Depth (mbgs)	7.85		9.20		7.80		17.44		14.90		7.80	
Top of Screen	268.95		269.39		268.60		259.36		262.13		268.03	
Bottom of Screen	265.95		266.39		265.60		256.36		259.13		265.03	
Ground Elev. (masl)	273.80		275.00		273.40		273.80		273.80		272.80	
Date	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)
19-Oct-18	DRY		DRY		DRY		DRY		14	259.80	DRY	
02-Nov-18	4.07	269.73	6.31	268.69	2.97	270.43	2.62	271.18	2.85	270.95	6.94	265.86
21-Dec-18	0.59	273.21	1.49	273.51	0.55	272.85	1.13	272.67	0.81	272.99	0.60	272.20
15-May-19	0.31	273.49	1.10	273.90	0.27	273.13	0.73	273.07	0.52	273.28	0.50	272.30
11-Nov-20	-	-	3.06	271.94	-	-	3.00	270.80	-	-	-	-

TABLE 1

GROUND WATER ELEVATIONS

West Half Lot 21, Concession 9 (Esquesing)

Glen Williams, ONTARIO

PROJECT #1-18-0438-46

Well ID	MW 10		MW 11		MW 12S		MW 12D		MW 13		MW 14	
Stick Up (m)	0.84		0.90		0.92		0.94		0.94		0.90	
Depth (mbgs)	7.84		7.81		4.66		7.68		7.73		7.60	
Top of Screen	268.56		269.79		267.74		266.22		268.07		269.58	
Bottom of Screen	265.56		266.79		266.24		263.22		265.07		266.58	
Ground Elev. (masl)	273.40		274.60		270.90		270.90		272.80		273.80	
Date	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)
19-Oct-18	DRY		DRY		DRY		5.8	265.10	DRY		6.7	267.10
02-Nov-18	4.55	268.85	3.40	271.20	DRY		4.66	266.24	5.82	266.98	4.92	268.88
21-Dec-18	0.82	272.58	1.29	273.31	3.31	267.59	3.51	267.39	3.46	269.34	4.65	269.15
15-May-19	0.08	273.32	0.70	273.90	1.93	268.97	2.25	268.65	1.00	271.80	1.48	272.32
11-Nov-20	-	-	3.43	271.17	-	-	-	-	-	-	-	-

TABLE 1

GROUND WATER ELEVATIONS

West Half Lot 21, Concession 9 (Esquesing)

Glen Williams, ONTARIO

PROJECT #1-18-0438-46

Well ID	MW 1		MW 2		MW 3S		MW 3D		MW 4	
Stick Up (m)	0.81		0.92		1.03		0.99		1.05	
Depth (mbgs)	7.73		7.82		4.16		7.80		15.27	
Top of Screen	268.37		268.68		271.24		269.10		261.03	
Bottom of Screen	265.37		265.68		269.74		266.10		258.03	
Ground Elev. (masl)	273.10		273.50		273.90		273.90		273.30	
Date	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)
19-Oct-18	DRY		DRY		DRY		DRY		14.3	259.00
02-Nov-18	4.18	268.92	5.06	268.44	2.55	271.35	2.39	271.51	2.72	270.58
21-Dec-18	0.725	272.38	0.18	273.32	0.22	273.68	0.59	273.31	0.92	272.38
15-May-19	0.350	272.75	0.10	273.40	0.12	273.78	0.22	273.68	0.54	272.76
11-Nov-20	-	-	2.18	271.32	2.33	271.57	2.42	271.48	-	-

TABLE 1

GROUND WATER ELEVATIONS

West Half Lot 21, Concession 9 (Esquesing)

Glen Williams, ONTARIO

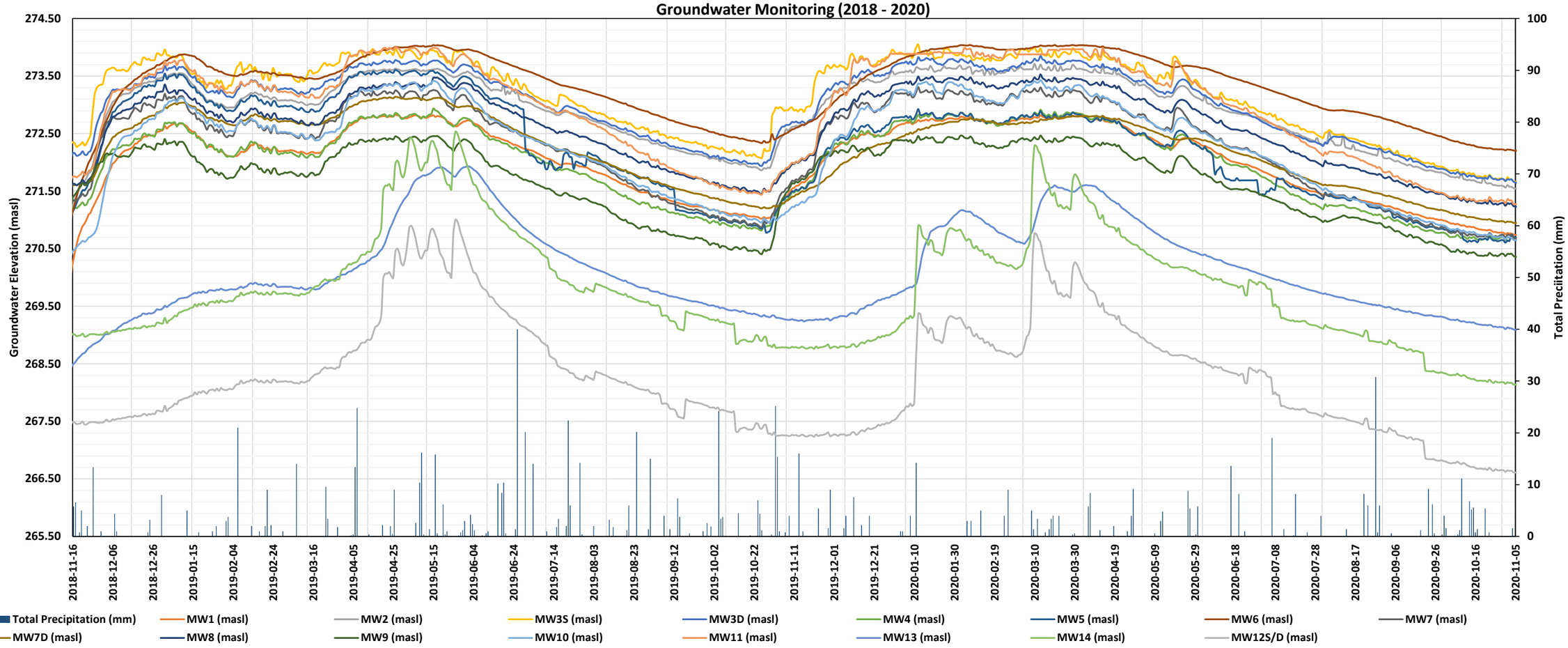
PROJECT #1-18-0438-46

Well ID	MW 5		MW 6		MW 7		MW 7D		MW 8		MW 9	
Stick Up (m)	0.94		1.10		1.02		1.03		1.07		0.91	
Depth (mbgs)	7.85		9.20		7.80		17.44		14.90		7.80	
Top of Screen	268.95		269.39		268.60		259.36		262.13		268.03	
Bottom of Screen	265.95		266.39		265.60		256.36		259.13		265.03	
Ground Elev. (masl)	273.80		275.00		273.40		273.80		273.80		272.80	
Date	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)	WL (m)	Elev. (masl)
19-Oct-18	DRY		DRY		DRY		DRY		14	259.80	DRY	
02-Nov-18	4.07	269.73	6.31	268.69	2.97	270.43	2.62	271.18	2.85	270.95	6.94	265.86
21-Dec-18	0.59	273.21	1.49	273.51	0.55	272.85	1.13	272.67	0.81	272.99	0.60	272.20
15-May-19	0.31	273.49	1.10	273.90	0.27	273.13	0.73	273.07	0.52	273.28	0.50	272.30
11-Nov-20	-	-	3.06	271.94	-	-	3.00	270.80	-	-	-	-

TABLE 2
GROUND WATER VERTICAL HYDRAULIC GRADIENTS
West Half Lot 21, Concession 9 (Esquesing)
Glen Williams, ONTARIO
PROJECT #1-18-0438-46

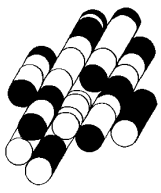
Well ID Pair	MW 3			MW 12		
Depth (mbgs) (A)	4.16			4.66		
Depth (mbgs) (B)	7.80			7.68		
Date	WL (S) (m)	WL (D) (m)	Gradient	WL (S) (m)	WL (D) (m)	Gradient
19-Oct-18	n/m			n/m		
02-Nov-18	2.55	2.39	-0.04	n/m		
21-Dec-18	0.22	0.59	0.10	3.31	3.51	0.07
15-May-19	0.12	0.22	0.03	1.93	2.25	0.11
11-Nov-20	2.33	2.42	0.02	-	-	-

LOT 21 CONCESSION, GLEN WILLIAMS, ONTARIO
Groundwater Monitoring (2018 - 2020)



APPENDIX K

TERRAPROBE INC.



Alignment: C-C'
From E:585415, N:4835010,
to E:585553, N:4834635

Elevation (m)

274 272 270 268 266 264 262 260 258 256

BH 3 — 50 mm dia. monitoring well
'N': 11 / 28 / 48 / 73 / 50 / 125mm / 50 / 50mm / 50 / 75mm / 50 / 125mm

BH 7D — 50 mm dia. monitoring well

BH 5 — 50 mm dia. monitoring well
'N': 9 / 65 / 83 / 50 / 150mm / 50 / 125mm / 50 / 100mm / 50 / 75mm

BH 8 — 50 mm dia. monitoring well
'N': 6 / 44 / 39 / 65 / 85 / 275mm / 50 / 125mm / 50 / 150mm / 50 / 100mm / 50 / 75mm / 50 / 125mm / 50 / 50mm

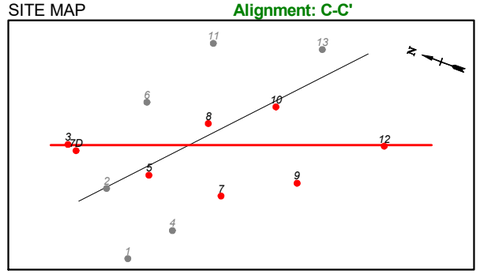
BH 7 — 50 mm dia. monitoring well
'N': 9 / 45 / 61 / 76 / 50 / 75mm / 50 / 75mm / 50 / 100mm
1 - 12 - 61 - 26

BH 10 — 50 mm dia. monitoring well
'N': 8 / 34 / 33 / 46 / 57 / 50 / 50mm / 50 / 125mm

BH 9 — 50 mm dia. monitoring well
'N': 16 / 50 / 150mm / 74 / 86 / 50 / 125mm / 50 / 125mm / 50 / 75mm / 50 / 125mm
2 - 16 - 58 - 24

BH 12 — 50 mm dia. monitoring well
'N': 6 / 14 / 10 / 7 / 23 / 50 / 75mm / 50 / 125mm / 50 / 75mm
37 - 46 - 12 - 5

SITE MAP — Alignment: C-C'



LITHOLOGY GRAPHIC LEGEND

- Topsoil
- Blank
- Sandy Clayey Silt
- Sand and Gravel
- Clayey Silt
- Bedrock

Boreholes Equally Spaced

INTERPRETIVE LEGEND

- WL on completion of drilling
- Stabilized WL, most recent

- *FILL*
- *GRAVELS (gravel to gravelly sand)*
- *SILT TO SAND (not till)*
- *COHESIONLESS TILLS*
- *COHESIVE SOILS (clayey silt to clay, incl. tills)*
- *DISTURBED/REWORKED SOILS*

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **SUBSURFACE PROFILE C-C'**

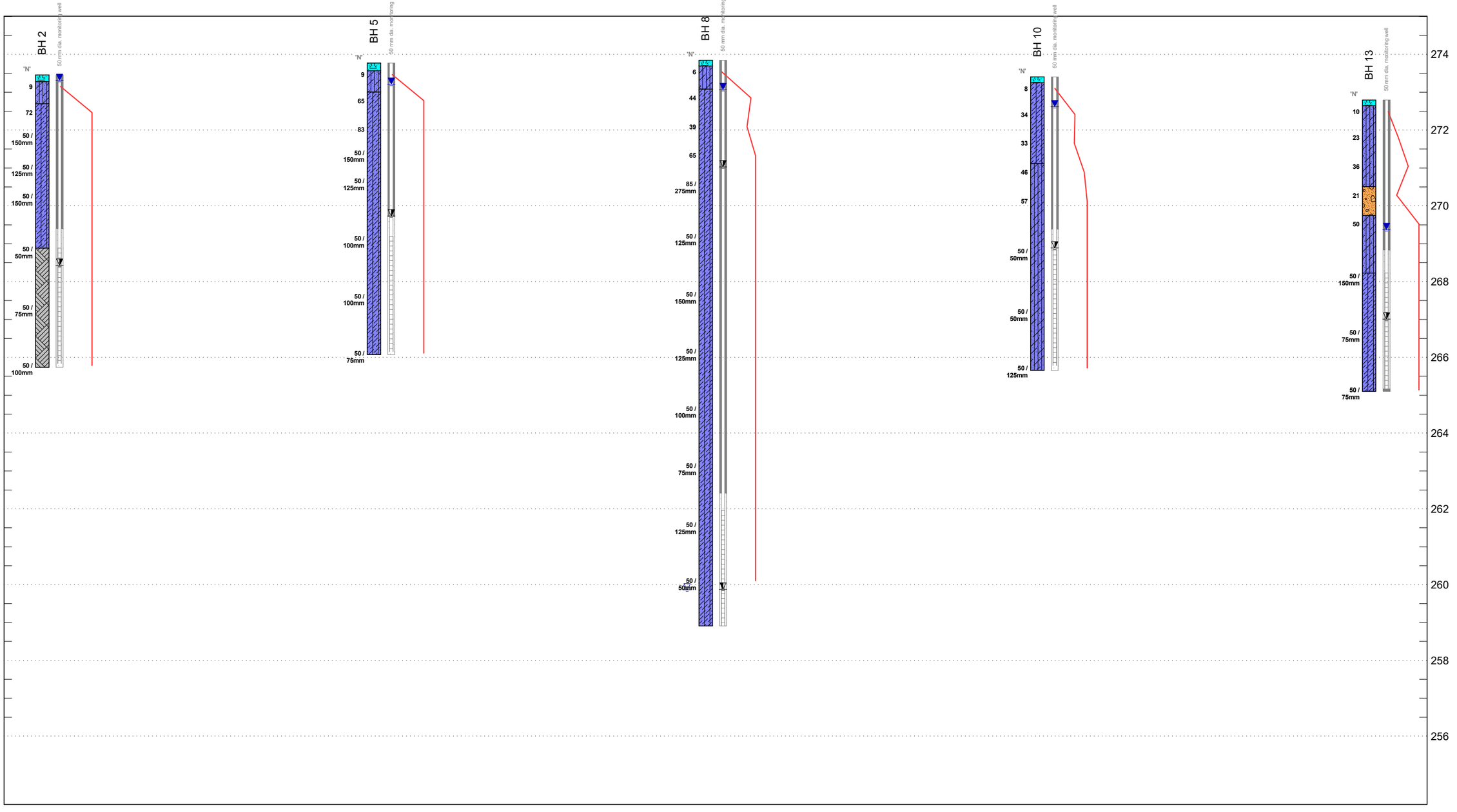
File No.: **1-18-0438**

Report: !SECTION - TABLOID - ELEV

Alignment: D-D'
From E:585369, N:4834962,
to E:585626, N:4834724

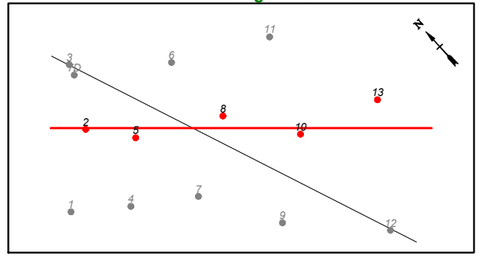
Elevation (m)

274
272
270
268
266
264
262
260
258
256



SITE MAP

Alignment: D-D'



LITHOLOGY GRAPHIC LEGEND

- Topsoil
- Sand and Gravel
- Sandy Clayey Silt
- Clayey Silt
- Bedrock

Boreholes Equally Spaced

INTERPRETIVE LEGEND

- WL on completion of drilling
- Stabilized WL, most recent

- *FILL*
- *GRAVELS (gravel to gravelly sand)*
- *SILT TO SAND (not till)*
- *COHESIONLESS TILLS*
- *COHESIVE SOILS (clayey silt to clay, incl. tills)*
- *DISTURBED/REWORKED SOILS*

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

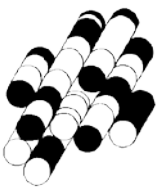
Title: **SUBSURFACE PROFILE D-D'**

File No.: **1-18-0438**

Report: !SECTION - TABLOID - ELEV

APPENDIX L

TERRAPROBE INC.



Material Name	Color	KS (m/s)
Top Soil		1e-006
Clayey Silt		1e-008
Silt to Gravel and Sand		1e-006

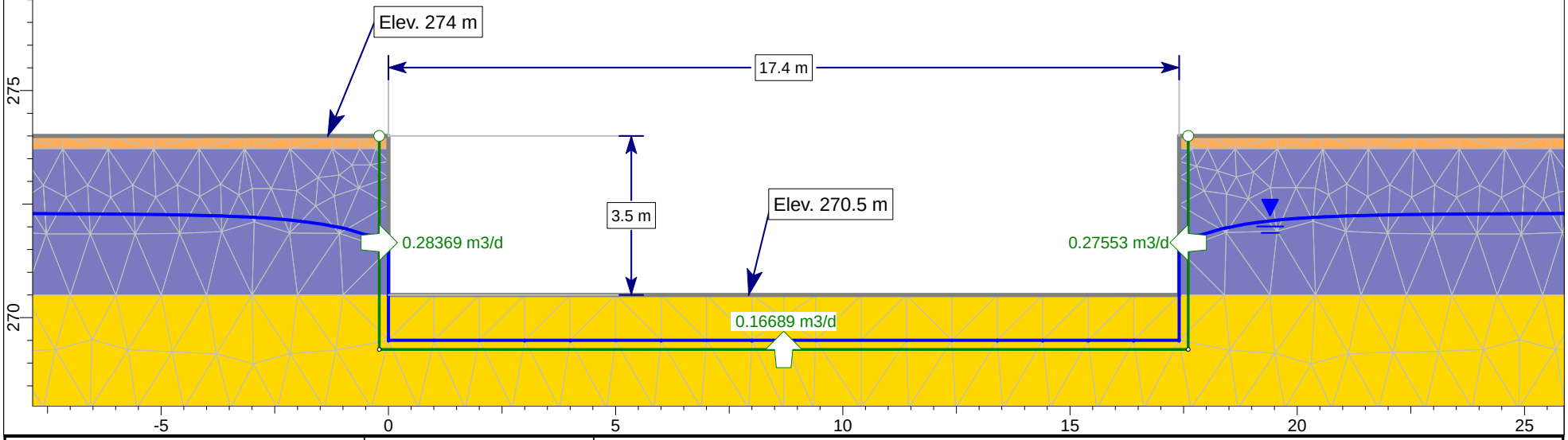
Excavation Dimensions: 17.4 m x17.4 m

Ground Surface: Elev. 274 masl
Finished Floor Elev. 271 masl
Base of Excavation: Elev.270.5 masl
Water Table: Elev. 272.3 masl
Dewatering Target: Elev. 269.5 masl

Q Ground Water = 34,000 L/day
(S.F. = 1.5)

25 mm of Rainfall Event: 8,000 L/day

Q Total= 42,000 L/day



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project
1-18-0438-46.1 l West Half Lot 21 Glen Williams

Analysis
Dewatering , Short Term-Single Lot , Dewatering (in the Lot 1 to Lot 6 area) South of Megan Drive

Date	Scale	File
2021-01-28	1:132	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc

Material Name	Color	KS (m/s)
Top Soil		1e-006
Clayey Silt		1e-008

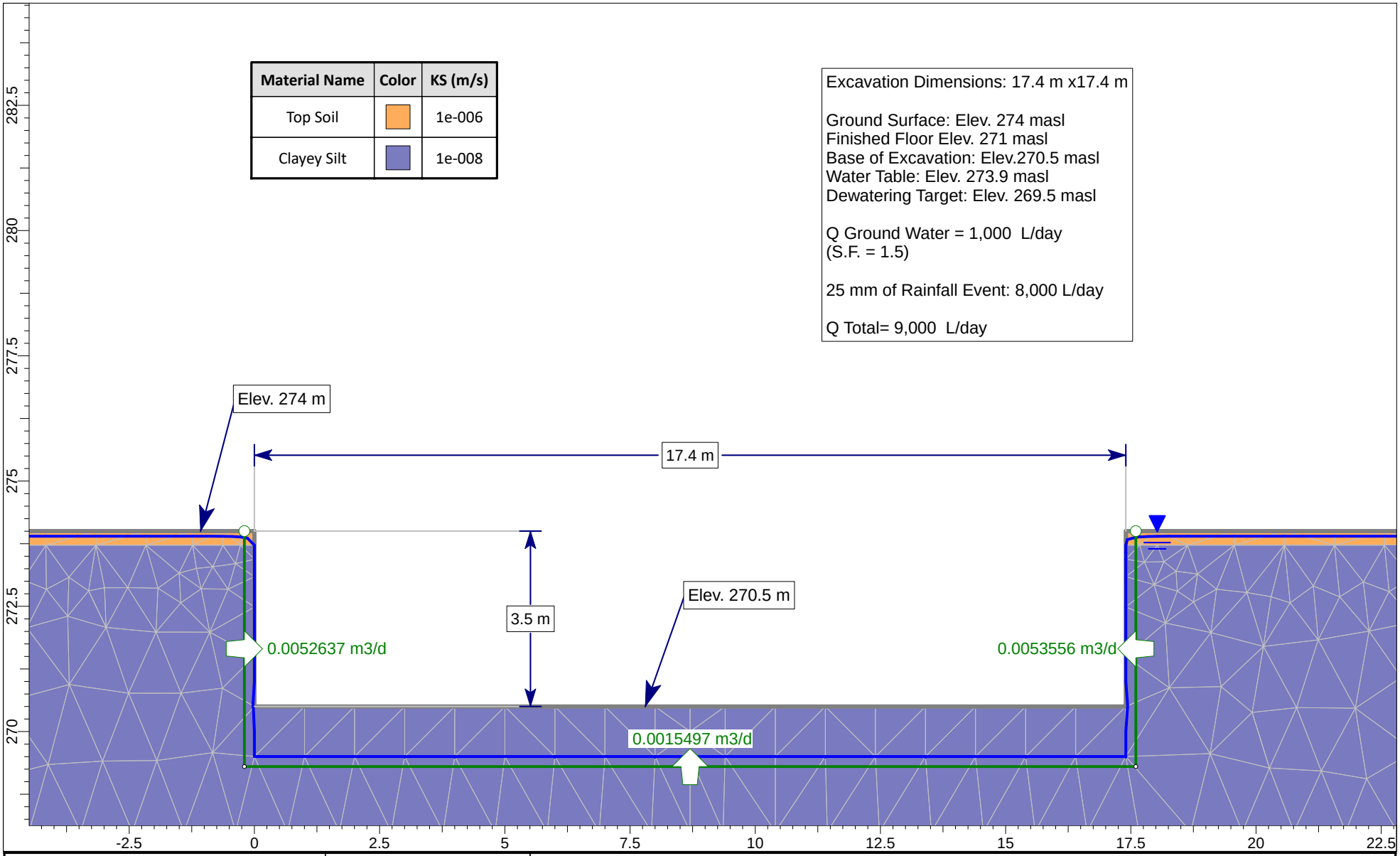
Excavation Dimensions: 17.4 m x17.4 m

Ground Surface: Elev. 274 masl
Finished Floor Elev. 271 masl
Base of Excavation: Elev.270.5 masl
Water Table: Elev. 273.9 masl
Dewatering Target: Elev. 269.5 masl

Q Ground Water = 1,000 L/day
(S.F. = 1.5)

25 mm of Rainfall Event: 8,000 L/day

Q Total= 9,000 L/day



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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 I West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term-Single Lot , Dewatering (in the Lot 7 to Lot 32 area) North of Megan Drive

Date	Scale	File
2021-01-28	1:107	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc

Material Name	Color	KS (m/s)
Top Soil		1e-006
Clayey Silt		1e-008
Silt to Gravel and Sand		1e-006

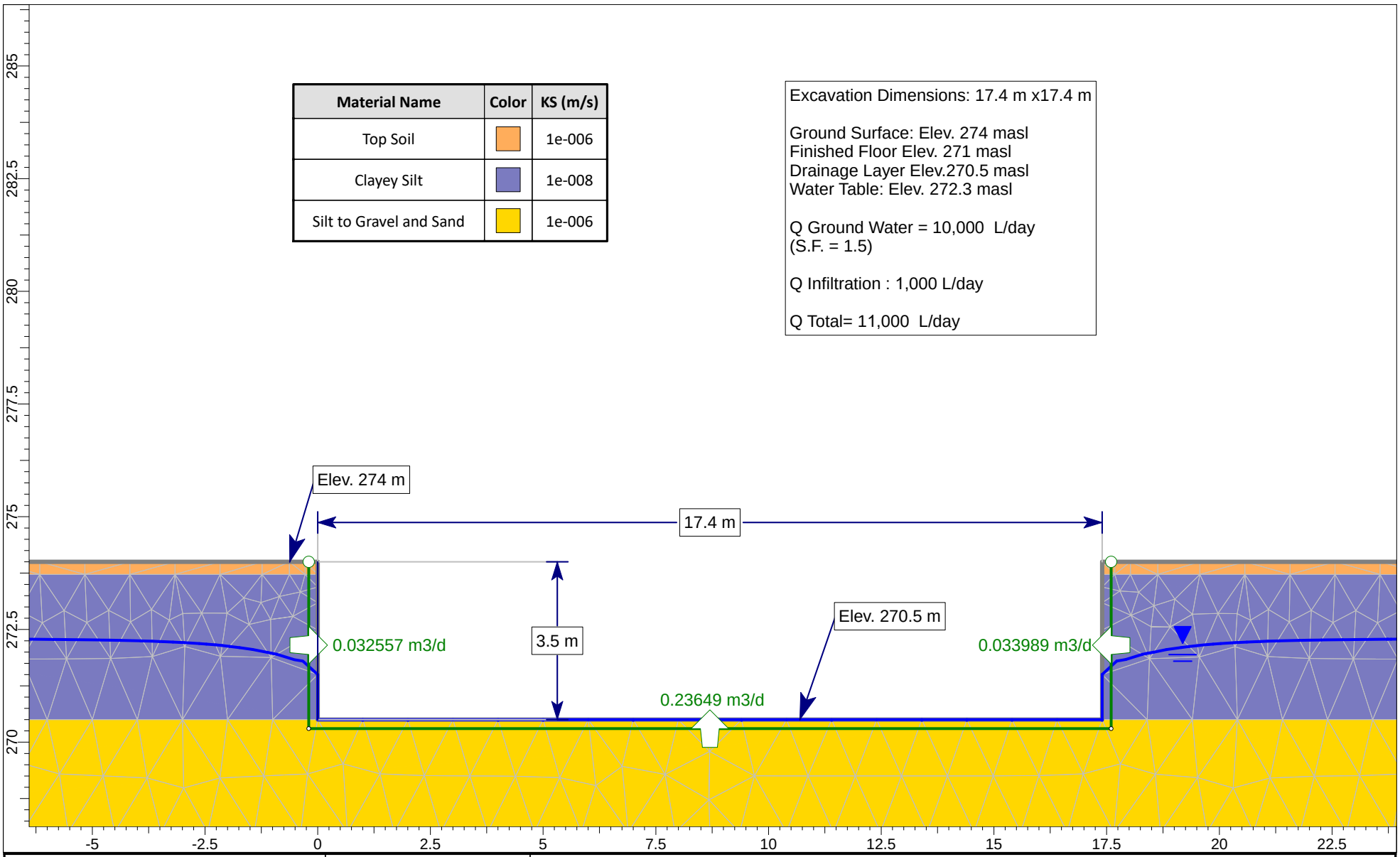
Excavation Dimensions: 17.4 m x17.4 m

Ground Surface: Elev. 274 masl
Finished Floor Elev. 271 masl
Drainage Layer Elev.270.5 masl
Water Table: Elev. 272.3 masl

Q Ground Water = 10,000 L/day
(S.F. = 1.5)

Q Infiltration : 1,000 L/day

Q Total= 11,000 L/day



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Long Term-Single Lot , Dewatering (in the Lot 7 to Lot 32 area) South of Megan Drive

Date	Scale	File
2021-01-28	1:119	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc

Material Name	Color	KS (m/s)
Top Soil		1e-006
Clayey Silt		1e-008

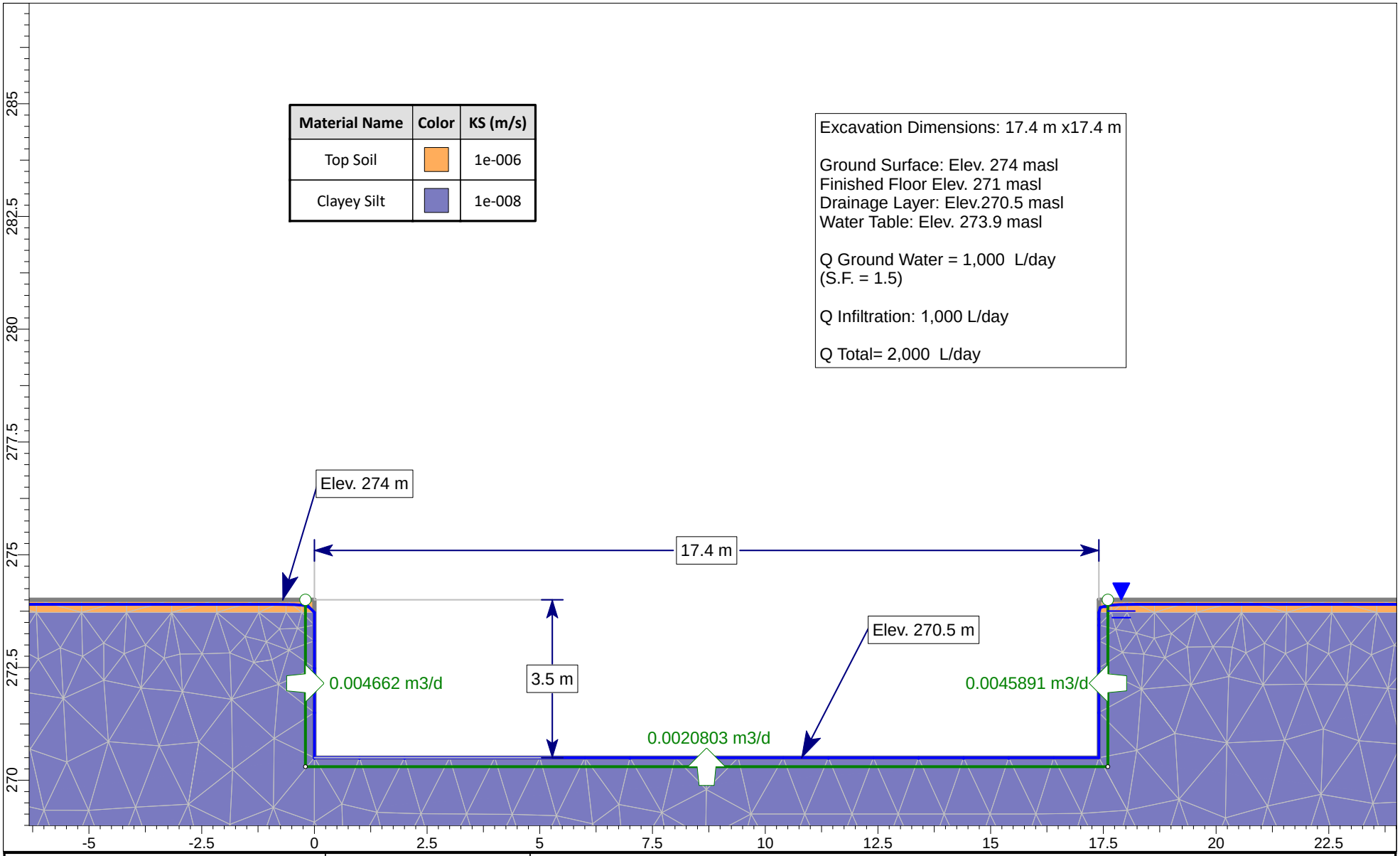
Excavation Dimensions: 17.4 m x17.4 m

Ground Surface: Elev. 274 masl
Finished Floor Elev. 271 masl
Drainage Layer: Elev.270.5 masl
Water Table: Elev. 273.9 masl

Q Ground Water = 1,000 L/day
(S.F. = 1.5)

Q Infiltration: 1,000 L/day

Q Total= 2,000 L/day



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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

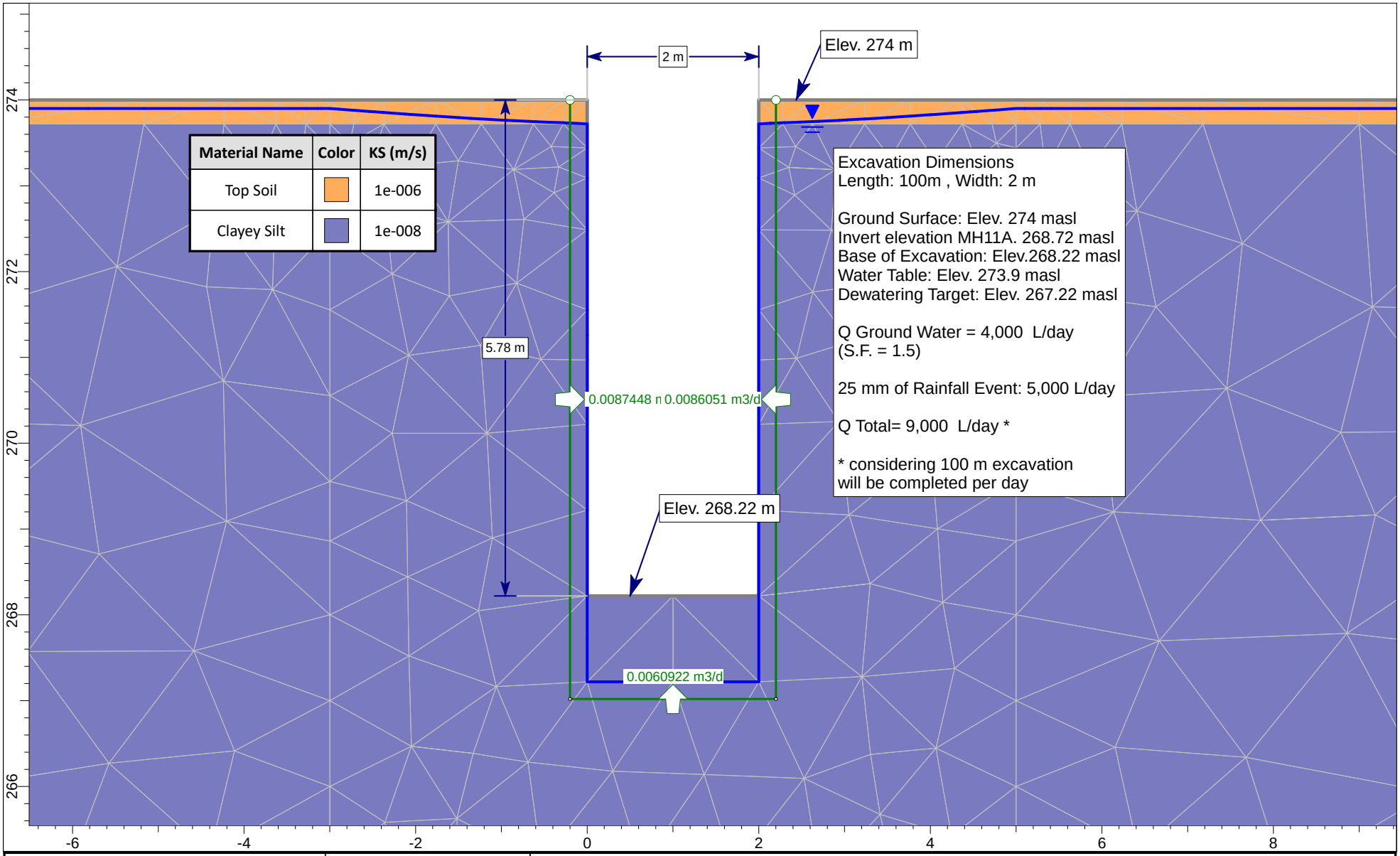
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Long Term-Single Lot , Dewatering (in the Lot 7 to Lot 32 area) North of Megan Drive

Date	Scale	File
2021-01-28	1:119	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



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SLIDEINTERPRET 7.038

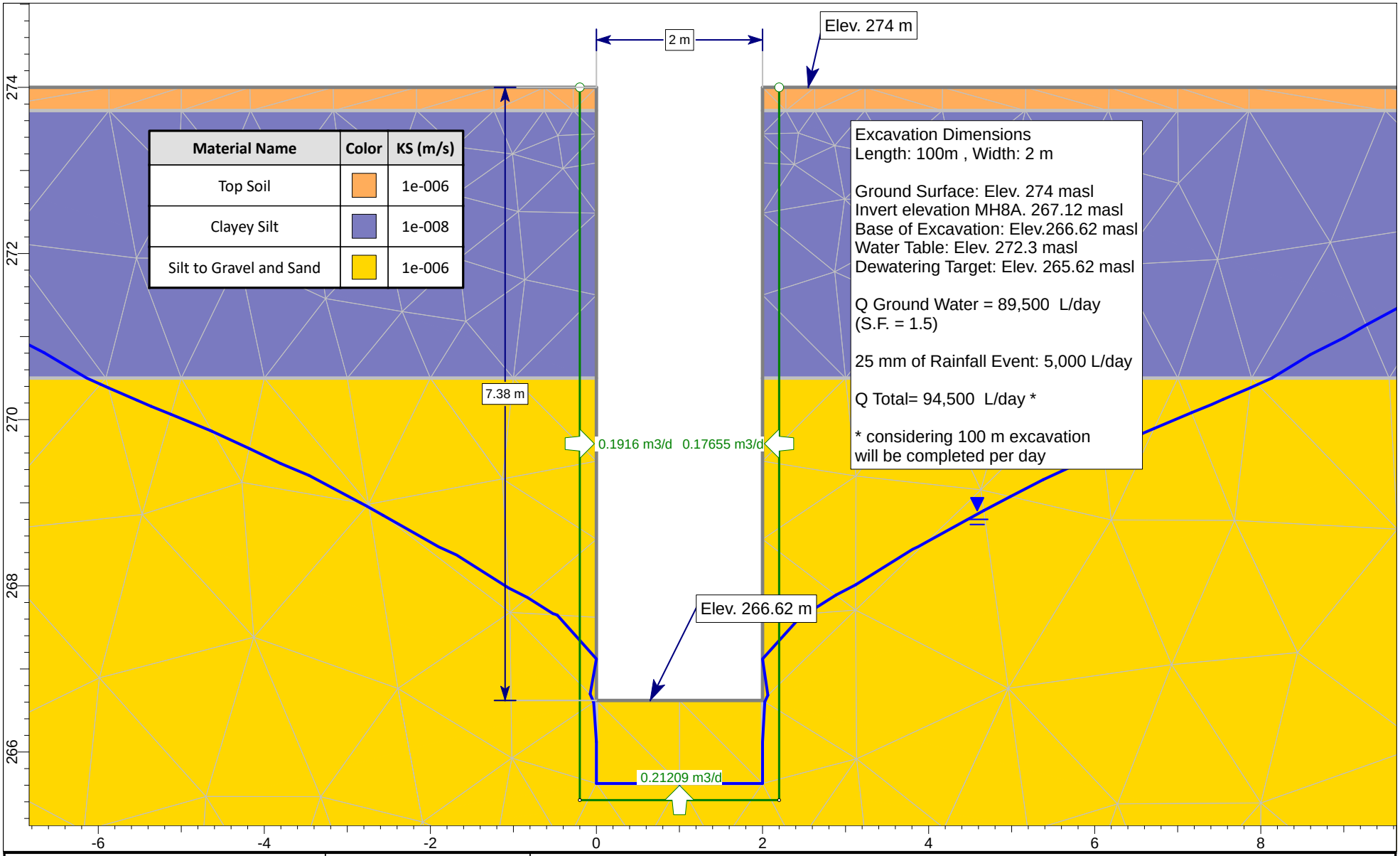
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term - Sanitary , Dewatering (100-meter length) North of Megan Drive

Date	Scale	File
2021-01-28	1:63	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



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SLIDEINTERPRET 7.038

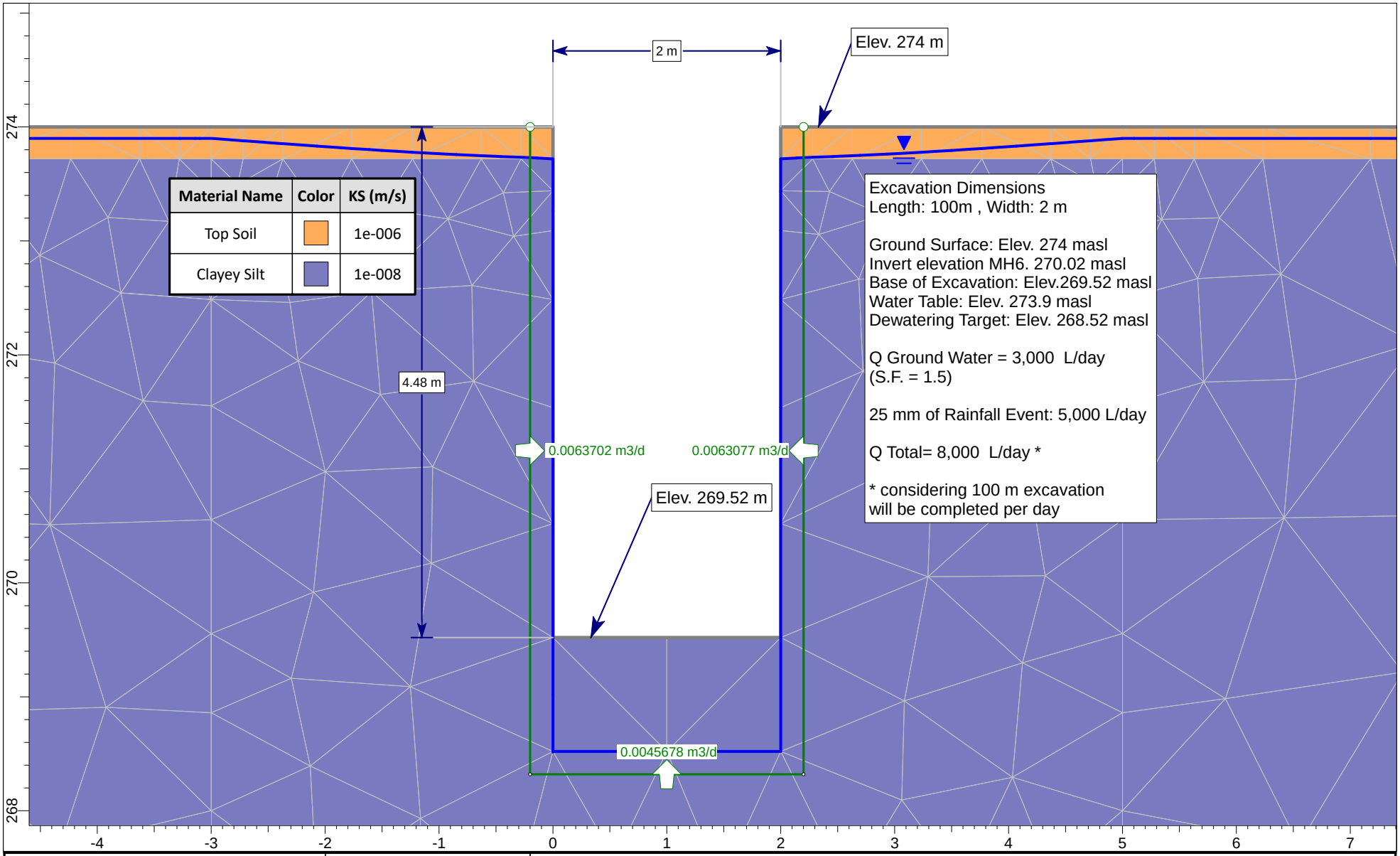
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term - Sanitary , Dewatering (100-meter length) South of Megan Drive

Date	Scale	File
2021-01-28	1:65	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



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Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

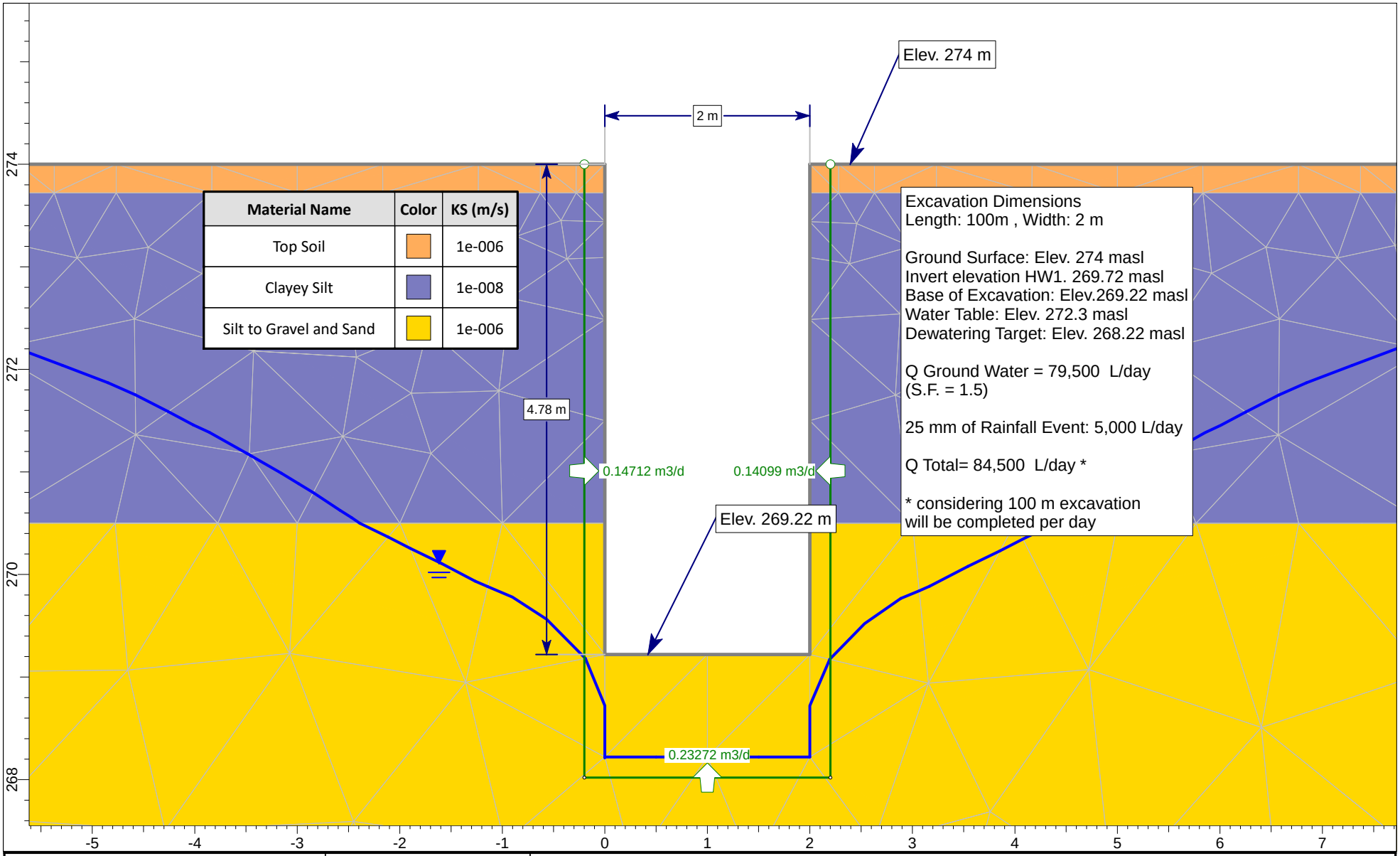
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term - Storm , Dewatering (100-meter length) North of Megan Drive

Date	Scale	File
2021-01-28	1:47	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



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Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

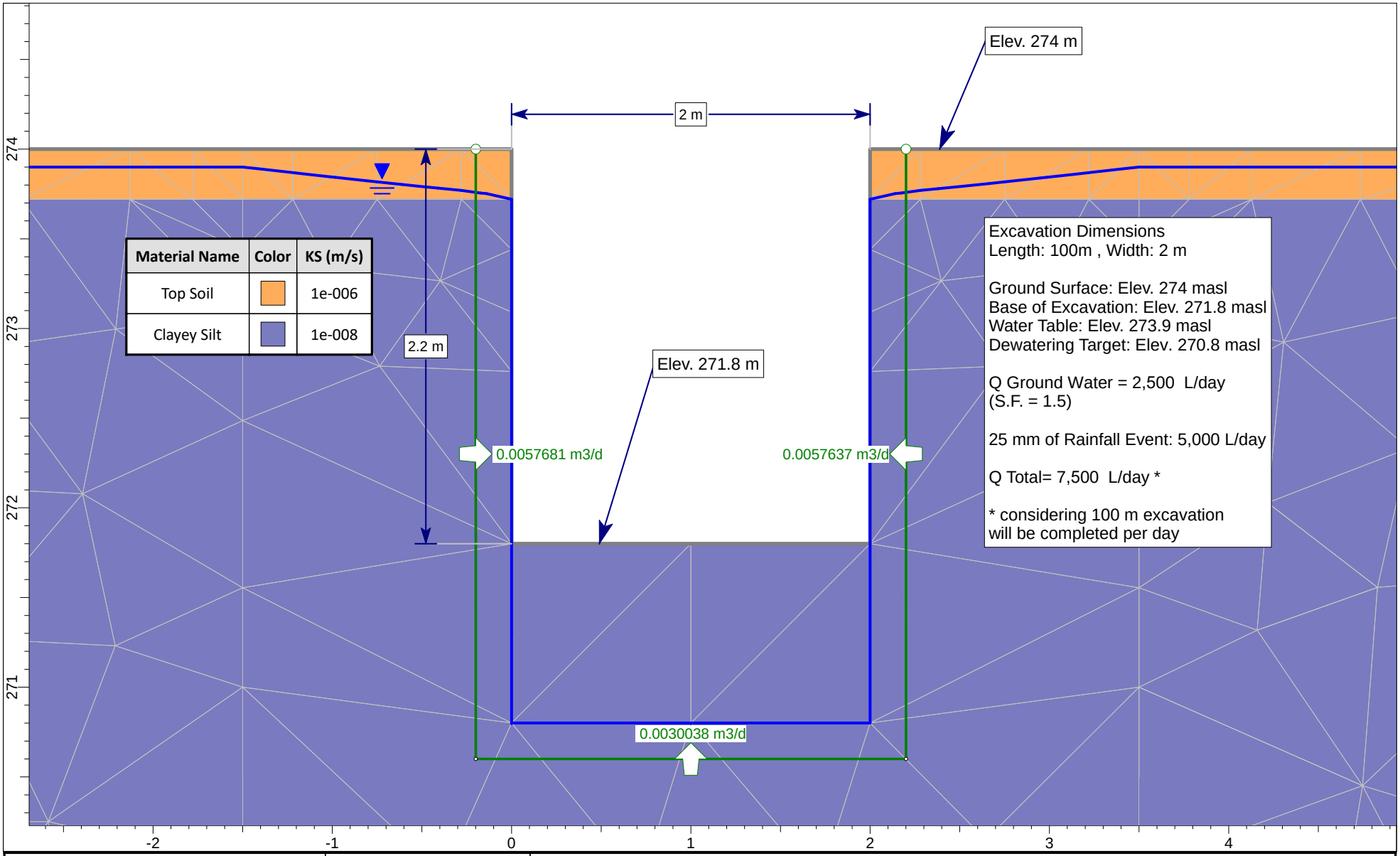
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term - Storm , Dewatering (100-meter length) South of Megan Drive

Date	Scale	File
2021-01-28	1:52	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



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Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

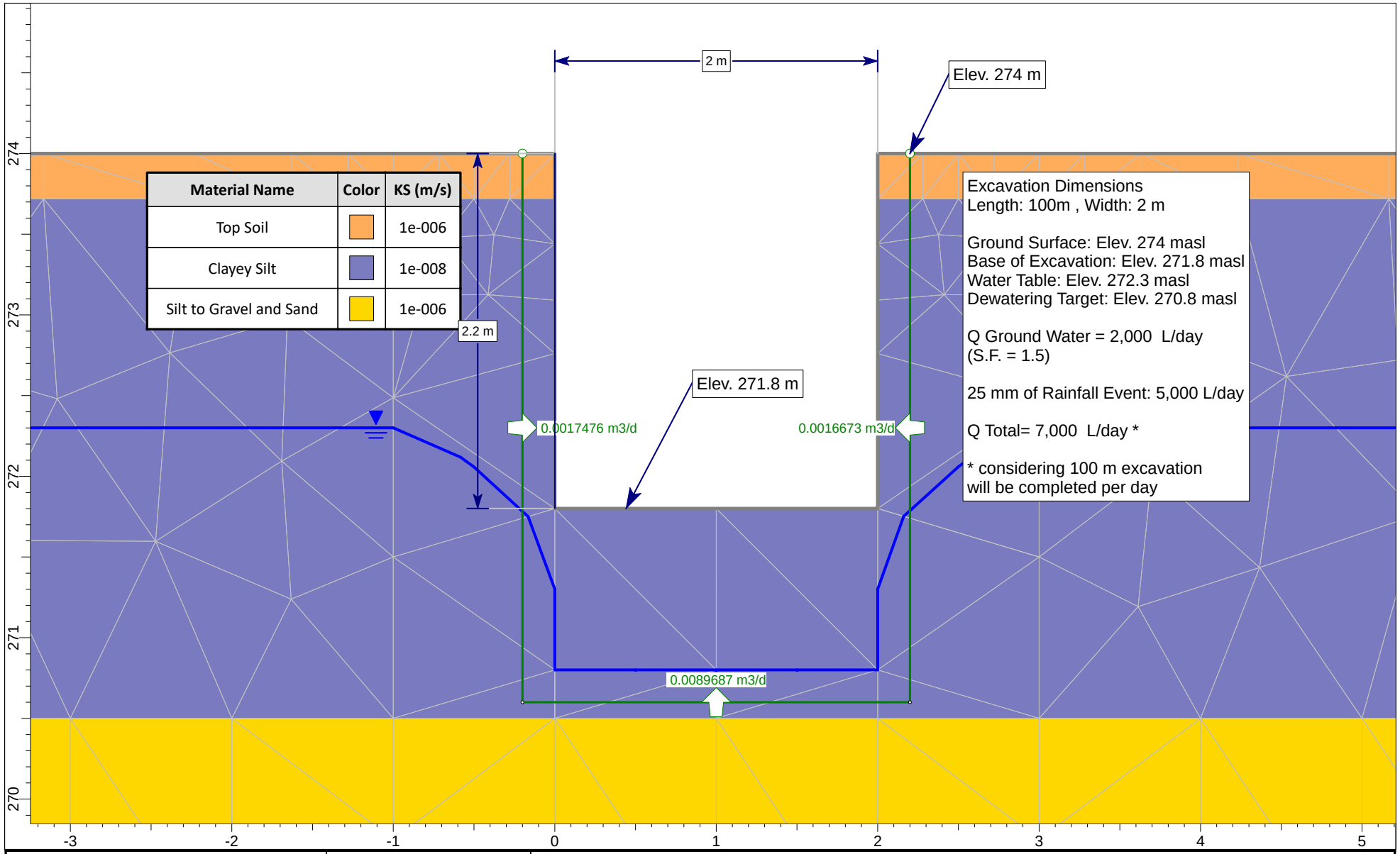
Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project: **1-18-0438-46.1 l West Half Lot 21 Glen Williams**

Analysis: Dewatering , Short Term - Watermain , Dewatering (100-meter length) North of Megan Drive

Date	Scale	File
2021-01-28	1:30	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 7.038

Notes
Refer to Hydrogeological Report for factual information supporting this analysis.

Project
1-18-0438-46.1 l West Half Lot 21 Glen Williams

Analysis
Dewatering , Short Term - Watermain , Dewatering (100-meter length) South of Megan Drive

Date	Scale	File
2021-01-28	1:33	1-18-0438-46.1.slmd

By	Company
UA	Terraprobe Inc